*June 1973*

# Smithsonian

Protected flamingos at Lake Nakuru in Kenya (see back cover and pp. 36-41)

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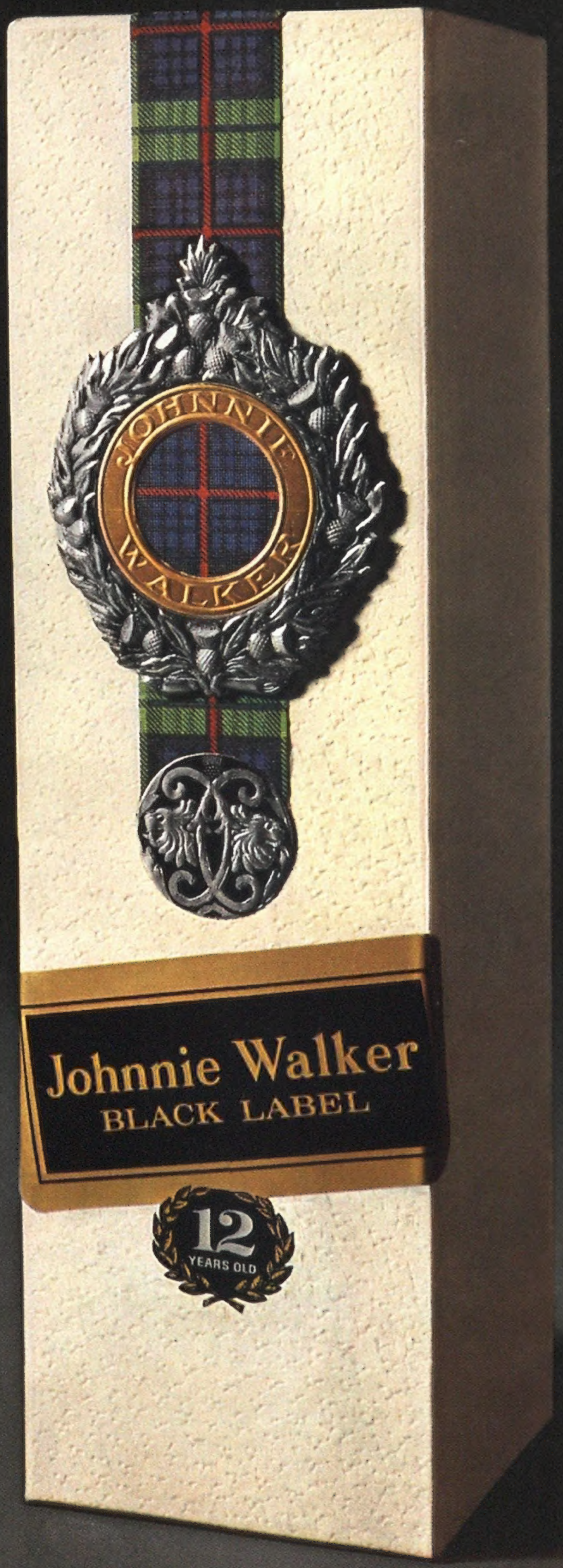


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# Smithsonian

Volume 4, Number 3

## *Table of Contents*

Front and back covers: Flamingos blanket the surface of Lake Nakuru, an ornithological reserve in Kenya (p. 36)
Photograph by John Reader

4 The view from the castle: Secretary Ripley discusses international efforts to save endangered wildlife

6 Phenomena, comment and notes: Vitamin C and sex, reprieve for the pupfish, the screwworm strikes back, Bicentennial hero-seeking and hybrid cricket chirps

12 Letters to the Editor

16 Lost colleagues and lost friends

18 An 11th-hour effort to save one of the world's great monuments—Borobudur, a thousand-year-old Buddhist temple in central Java, Indonesia
Photographs and text by Eliot Elisofon

26 The American diet is democratized from salt fish to frozen berries, bringing dishes for every palate
By Daniel J. Boorstin
Drawings by Dill Cole

36 Biologists help conserve the teeming waterfowl of Lake Nakuru, a protected national park in Kenya
Text and photographs by John Reader

42 'Perfect' species of brain coral

46 Inventor William Lear, young at 70, strikes a blow for clean air with a new version of the Stanley Steamer
By William Childress
Photographs by Jon Brenneis

54 Where the beaches have been going: into the ocean—ironically hastened by man-made 'remedies'
By Gary Soucie

62 Monticello's long career—from riches to rags to riches—and how a Russian immigrant helped save it
By Thomas Fleming

70 The dazzling crystals that man can make
Text and photographs by Joel E. Arem

78 Book reviews

84 June events at the Smithsonian

88 An automated Rx for psychosomatics
By Patrick Ryan

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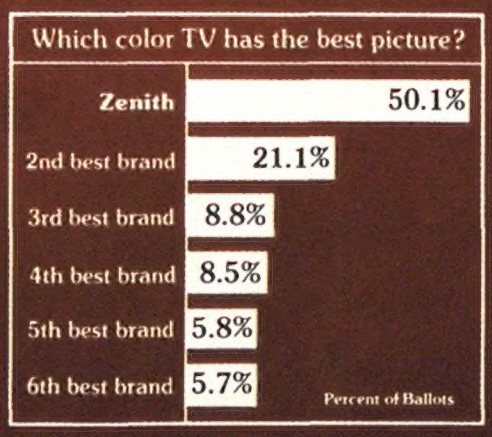


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*Secretary Ripley's comments*

# *The view from the castle*

*A recently framed international convention gives the world's endangered wildlife its best chance yet—if the nations ratify it soon*

More has been done in the past year for conservation at the international level than ever before in Man's history. There was the U.N. Conference on the Human Environment in Stockholm last June and, a month later in London, the first truly conservation-minded whaling conference. Then, this past February and March, delegates from 88 nations met in Washington and, under the diplomatic chairmanship of Christian A. Herter jr., framed an international convention on endangered species.

The convention would be administered through Maurice Strong's U.N. Environmental Secretariat. It covers three categories of endangered plants and animals and their "recognizable products."

The *most* endangered species, some 375 that are threatened with extinction, are to be banned from all international trade. Export *and* import permits would be granted only for special research or authentic efforts to save the species by rearing it in captivity. Among mammals in this category are many lemurs, rare monkeys, gorillas and chimps, certain whales and bears, most of the big cats including the tiger, rhinos and many of the deer tribe.

Among birds are the "toki" or crested ibis of Japan (down to less than a dozen individuals), the California condor (probably less than 60), the Philippine monkey-eating eagle (probably less than 100) and many falcons (nearly demolished by the use of pesticides). For some reason, the pink-headed duck got on the list, although we bade it goodbye several years ago. Several species of pines, orchids and jungle trees beloved by commerce are also on the list. Clearly, time is running out for many others.

A second category contains some 25,000 species of animals and plants that are declining in number but not yet in danger of extinction. For these, only export permits would be required. Among them are several species of monkey such as the capuchin, anteaters, polar bears, most of the cats not in the first list and many seals. The birds include a variety of ducks, pheasants and hornbill species. Also one finds here the crocodilians and turtles as well as iguanas and monitor lizards; rare palms, wild cyclamen species and all species of orchids in the wild. Finally, a third list of creatures is reserved for those that may be locally threatened but not throughout their whole range.

The new convention remains to be ratified by the nations concerned and will not come into effect until at least ten of them have done so. Even then there is a "grandfather clause" which would exempt all transactions prior to the time the convention comes into force.

During the conference, an international ring smuggling vast quantities of spotted cat and other wild cat pelts was cracked in New York. For the delegates present, this was undoubtedly a strong reminder that the threat is real and the problem urgent. If 25 or 30 nations can ratify the convention fairly soon, one of the most significant landmarks in international conservation will have been achieved. It would be a first giant step in evoking an international consensus that Man alone is not the inheritor of all the Earth possesses, and that these fruits of our planet were not created solely for his self-gratification.

S. Dillon Ripley

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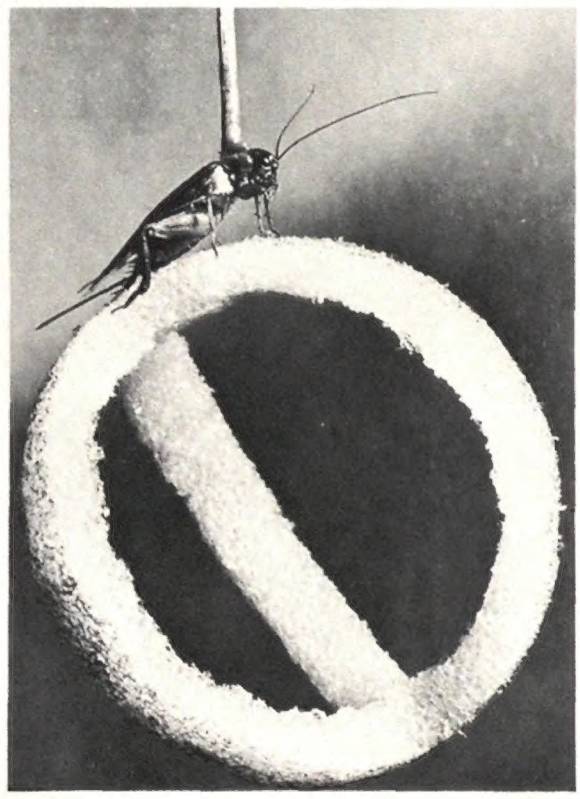
# *Phenomena, comment and notes*

*Vitamin C and sex, the pupfish gains a reprieve, the screwworm strikes back, hero-seeking and hybrid chirps*

The cricket chirping on your hearth is, of course, not chirping for your benefit. It is a male, sending out a precise rhythmic call for a mate. The rhythm varies from species to species, and this fact alone has provided ample work for a number of biologists armed with curiosity and some elaborate hi-fi equipment.



Tethered female cricket walks styrofoam Y-maze as male songs are played from sides.

One aspect of this phenomenon is that female crickets do not sing: They receive —but how, and how accurately, is still a bit unclear. To explore these questions, two biologists at the State University of New York at Stony Brook played the songs of two distinct Australian cricket species to selected females and observed their responses in a Y-maze. (Rather than put the crickets in the maze, they put the maze to the crickets, as shown in the photograph.) For the most part, the females "turned" in the direction of their proper song, avoiding the recorded attentions of males of the wrong type.

The two species could, however, be induced to hybridize, and this mixing up of genes created a hybrid chirp which the biologists were soon tuning towards the hybrid females. Writing in *Science,* Ronald R. Hoy and Robert C. Paul report that "female hybrids can not only identify the song of a sibling hybrid male but find it more attractive than parental song." From this they infer that the neurological receiving equipment of the females—the "template" that matches the male's song—is genetically determined, perhaps by a set of genes that is common with the males.

Nothing, however, is perfect or simple. The biologists found that some of their crickets, like some people, were "right-biased" or "left-biased," always turning one way regardless of the song played. And template or no, if a female does not hear her specific song, after a while she may just march off in the direction of the male of the other species—thus, perhaps, accounting for those hybrids.

### *Looking for a hero*

In the April issue of this magazine, Richard W. O'Donnell showed up Paul Revere for what he really was, thus leaving in some minds an awkward gap in the diadem of American Revolutionary heroes. With the Bicentennial only three years off, it was predictable that buffs and local boosters would rush in with replacements. One of the first was a lead miner from what is now Dubuque, Iowa.

The Dubuque Five Flags Civic Center committee seeks to build a memorial to Jean Marie Cardinal, a Frenchman who made a hurried canoe trip down the Mississippi in 1780 to warn the French and Spanish inhabitants of St. Louis that the British (not to mention some Sioux) were

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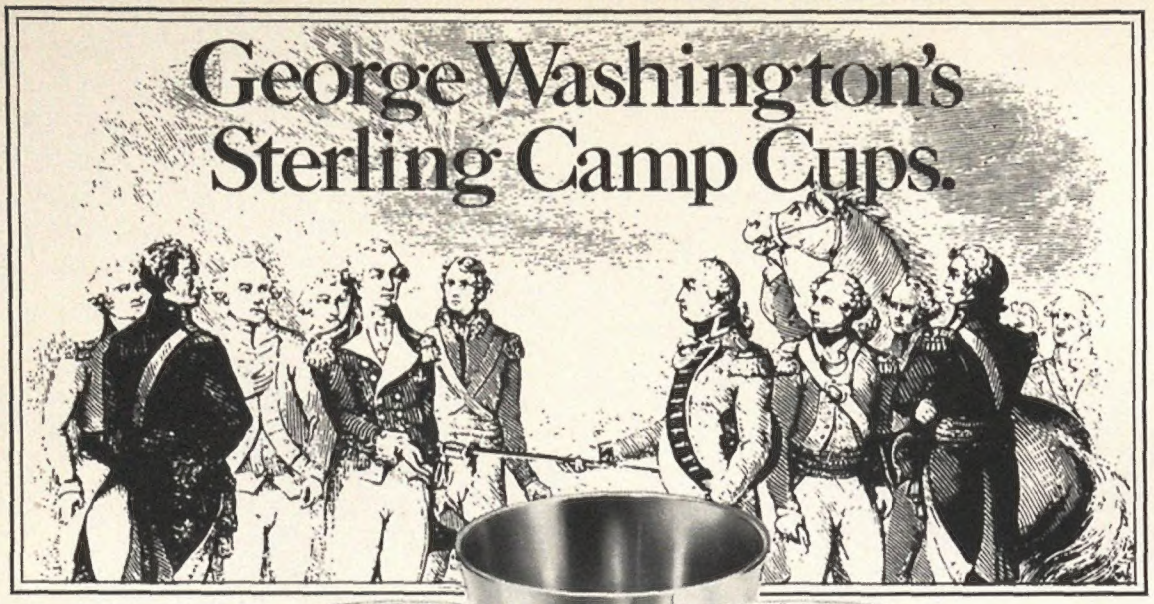

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coming. Indeed they were, and Cardinal died in the city's defense, but a forewarned St. Louis withstood the British attack. Had the British won St. Louis, claims at least one historian, the treaty of 1782 might have drawn the western boundary of the new republic along the Allegheny Mountains rather than down the Mississippi.

Before Cardinal is too elaborately celebrated, however, it should be noted that he had a fairly murky past. It seems he had come to the lead mines in the 1760s as a fugitive from justice, having been implicated in the mysterious death of two English trappers.

The bidding, then, is still open.

*Not by committee alone*

Are you among those worried that in our highly technical and organized nation, where all things seem to flow only from committees, there may be little room for an individual to have an impact? If so, there is a morsel of good news from the National Science Foundation, an organization that knows about such things.

Looking into the time lag between the conception of an idea and its arrival on the scene as a viable product or process, an NSF panel examined ten innovations, ranging from hybrid corn and oral contraceptives to xerography and the video tape recorder. The average time lag was 19 years, and there was no evidence that the lag is decreasing, even though one might expect that so technology-minded a nation would have learned to deal with inventions with increasing alacrity.

What NSF did find was that, in almost every case, success in getting from idea to product depended in large part on the efforts of one "technical entrepreneur"—an individual champion who persisted, often against current wisdom. "We are forced to conclude," wrote the NSF panel, "that innovation cannot be completely controlled or programmed."

*Beach pests beware*

While the nation's beaches disappear (see page 54) a bane of the beachgoer—the biting fly—doesn't. The greenhead fly and the deerfly in particular are active during the day, ranging far from their salt marsh breeding grounds suddenly to convert supine sunbathers into flailing, cursing dervishes.

So far, the main defense has been to spray the marshes with pesticides but this is expensive and ecologically unsound. What to do? Under a grant from the National Oceanic and Atmospheric Administration, Dr. E. P. Catts of the University of Delaware has been studying the hunting behavior of these ferocious pests. The trick seems to be to find the regular routes the flies take from the marsh and to construct traps to head them off from the beach.

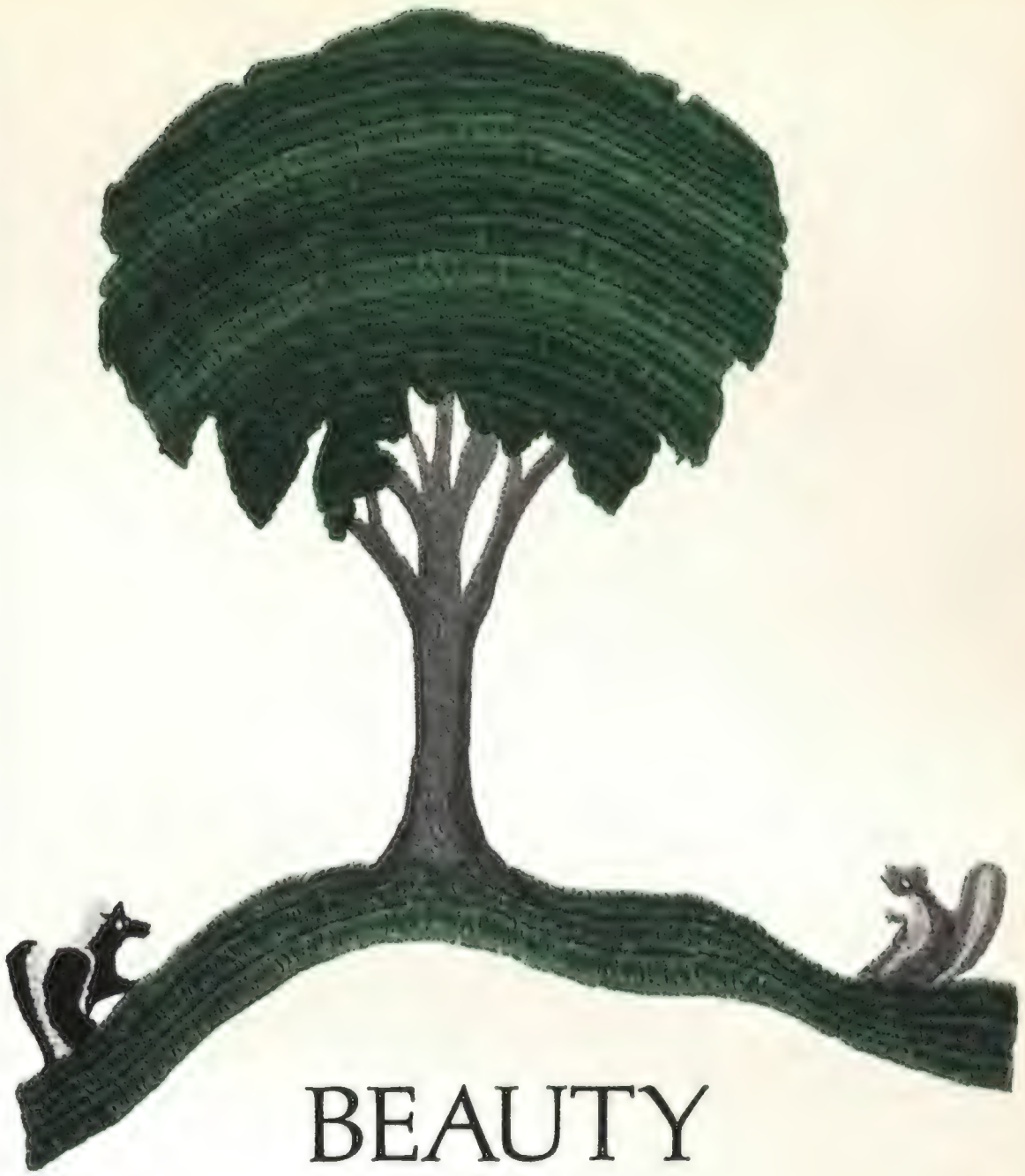
Dr. Catt's traps are fairly sophisticated items built on the principle of flypaper and in one month last summer he caught 350,000 greenhead flies, which is a lot when you think that Delaware beachgoers thus missed being bitten some 350,000 times. This summer Dr. Catts hopes to zero in on the deerfly. In the interim, until his techniques are perfected and in general use, you will simply have to swat.

*Vitamin C and sex*

A few years back the Nobel Prize-winning chemist, Linus Pauling, took up the cause of vitamin C as a preventive of colds, and the scorn that was immediately heaped upon the idea by his scientific colleagues did little to slow down the boom that began in the sale of vitamin C pills. Many people still scoff at the curative value of large doses of vitamin C (though everyone agrees that some dietary dosage is needed since humans—and guinea pigs—don't manufacture their own). But evidence is accumulating that there may be more to the idea than folklore and wishful thinking. Ascorbic acid's effects may reach even beyond the common cold.

By using himself as a guinea pig, a protégé of Pauling's, Fred Dice of Stanford University, has shown that vitamin C might also prove useful as a replacement for insulin in the treatment of diabetes.

But the real point of the vitamin C boom is the prevention of colds. Does it or doesn't it? Cedric Wilson, a pharmacologist at the University of Dublin, writes in *New Scientist* that it does—sometimes. His particular guinea pigs were boarding-school children in Dublin, some of whom were fed vitamin C pills over nine months, some of whom got dummy pills. (He also worked with real guinea pigs.) By studying the blood levels of vitamin C during stress periods, Professor Wilson determined that females of both species are better able to adjust their me-

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tabolisms to use vitamin C than males. (His results on sex differences in guinea-pig use of vitamin C have already been questioned by other British researchers.)

Wilson's boarding-school results were thus: Girls with 200 milligrams a day had less severe and less complex head colds than girls on placebos. Girls with 500 milligrams were even better off. On the other hand, a 200-milligram dose seems to make a boy's cold worse; 500 milligrams made the boys' colds revert to the same intensity as those of boys who were fed dummy pills. Yet before males give up all hope for fast, fast relief, it was found that vitamin C reduced the *complexity* of a male cold—that is, there would be fewer symptoms.

Thus science labors to catch up with Dr. Pauling (who is known on some campuses as VitaMan) and until it does one way or the other, these findings are reported as findings only, not necessarily as recommendations.

*Reprieve for the pupfish*

In July last year, SMITHSONIAN reported that the Devils Hole pupfish was in serious trouble. Fewer than 100 members of this species were left, inhabitants of a single spring-fed pool in Death Valley, Nevada. An agricultural concern was pumping water from the ground at several points nearby, thus lowering the water in Devils Hole, and it appeared that the pupfish was about to go down the drain unless action was taken. It has been.

Now a federal judge in Las Vegas has handed down a preliminary injunction calling for a mutually satisfactory "special master" to be appointed who would set limits to the pumping in order to insure enough water for the pupfishes' spawning ground. Said Dr. Willis King of the Bureau of Sports Fisheries and Wildlife, "It's an encouraging first step."

*Back to the water wheel*

While everyone is worried about power supplies, one source of energy seems to be abundant—the energy of the human imagination, which has been turned loose on the business of finding alternative and clean sources of power.

One of the cleanest—and the oldest—is using the flow of water to turn a wheel or a turbine, but hydroelectric plants call for damming rivers and that can have ill effects ecologically. But rivers are just one part of the global water cycle and two physicists, writing in *Scientific American,* suggest that a large bay in the Persian Gulf be closed off. Before long, the sun would evaporate much of the new reservoir's water, lowering its level below that of the rest of the Gulf. Then, by admitting water back in through the dam at the same rate as it is evaporating, you would have a vast hydroelectric project.

Such concepts, however, call for large-scale interference with a considerable amount of international real estate. It would be nice if you could build a hydroelectric plant without a dam, and that is what John R. Apel of the National Oceanic and Atmospheric Administration wants to do, according to *Science News.*

His "river" is the Gulf Stream, specifically where it flows at a relatively steady rate between Miami and the Biminis. Here, huge windmill-like machines could be placed underwater and, so long as the Gulf Stream flows, the water wheels would slowly, steadily grind out electricity from the current's upper levels.

*Again the screwworm*

One of the most spectacular successes in the annals of biological control of pests was the case of the screwworm, long a plague to the American livestock industry. By mass-producing sterile flies of the species and releasing them to mate with the wild females, the annual cases of screwworm infection plummeted from an estimated 50,000 to a mere 150-odd in eight years. (Part of the effort was a "barrier" of regular releases of sterile flies maintained between this country and uncontrolled Mexico.) But then, two years later in 1972, there was an explosion of more than 90,000 cases of the infection in the United States.

Perhaps the barrier was not sufficiently wide: Efforts are under way to expand and strengthen it. But *Nature* magazine suggests that the problem may be behavioral. Over the years, the stock from which the factory-produced sterile males come may have altered mating behavior patterns to the point that wild females avoid the "domesticated" males and mate only with wild ones. In any event, whatever is done about the barrier, the United States must start all over again to control its own new screwworm population.

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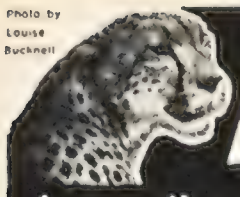
Photo by Louise Bucknell



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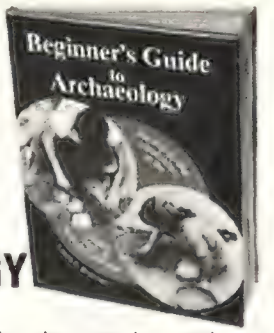


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# *Letters to the Editor*

*Paul Revere*

Dear Sir: I think Richard W. O'Donnell's article on Paul Revere in the April issue is a disservice to our country. There is too much debunking of national heroes of late—George Washington supposedly a "rounder" and Revere a "beans-spiller."

I truly wonder if the "discoverers" of these tidbits realize at all the negative effect their efforts cannot help but have on young Americans.

*The Reverend Robert A. Garvey*
Saint Francis Borgia Church
Blair, Nebraska

Dear Sir: When I was small I believed in Santa Claus and was pretty well advanced before I learned better. However, that

"The fate of a nation

Paul Revere might not have done all that Longfellow said he did, or that Paul did not know his own steed's name—*never!*
*Robert C. Morton*
Homestead, Florida

Dear Sir: My fifth-grade class has just finished studying about Paul Revere at school, and our books tell a different story from your article. My teacher says your article "makes you wonder if we really did win the war."
*Carole Kaufman*
Palos Verdes, California
*Edmund S. Morgan, professor of history at Yale, noted in his introduction to "Paul Revere's Three Accounts of his Famous Ride" (for the Massachusetts Historical Society) that Longfellow took the story "out of the hands of historians and at one stroke re-created Paul Revere, in a ballad that has outlived both its factual inaccuracies and the scorn of literary critics. . . . Historians have deplored the poet's mistakes, for example, in portraying Revere as waiting for the signal in the Old North Church steeple when actually the signal was given on Revere's own instructions before he left Boston. . . ."* Ed.

Dear Sir: During my ministry at the "original Old North Church" in Boston, from 1958 to 1964, I carried on research that indicates that *even* the church now shown to tourists is not the correct place! My findings were widely published at the time and created quite a furore.

was riding that night. . . ."


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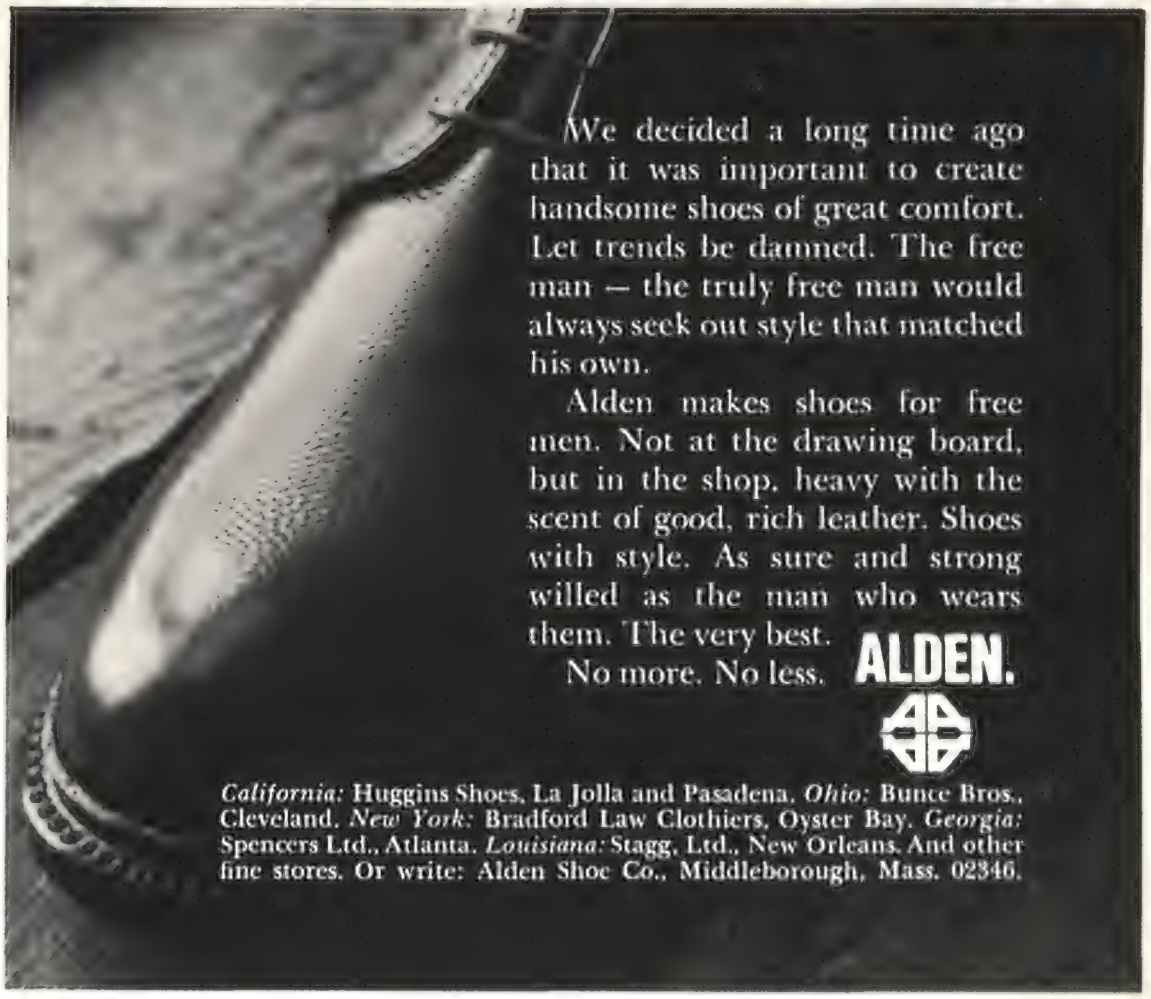

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The second church in Boston, built in 1676, is the original Old North. Christ Church, the one now shown to tourists, was founded in 1723 and is 300 yards from the original. After the Old North was used as a signal site, British troops under Lord Howe tore it down in 1776.
*The Reverend Dr. John Nicholls Booth*
Covina Valley Unitarian Church
Covina, California
*Confusion over the two churches has existed ever since Paul Revere himself referred to the church where the lanterns were hung as "North Church steeple" (1798). Most historians now agree that he was referring to Christ Church as the then oldest church in North Boston, since the original "Old North" had been torn down by the British.* Ed.

## *Copernicus*

Dear Sir: In Dr. J. Bronowski's article on Copernicus, there is one error. He calls Avicenna an Arab. This remarkable man was born in Bukhara in Turkestan, but spent most of his life in Iran.
*F. Taylor Gurney*
Iran-America Society
Washington, D.C.
*Mr. Gurney is correct. Avicenna was a Persian philosopher and physician. But most of his writings were in Arabic.* Ed.

## *Methadone*

Dear Sir: Your articles on the methadone controversy were most stimulating. I agree with Henry L. Lennard *et al* that methadone is not the important rehabilitative tool its sponsors have claimed but simply the transfer from hard drugs to another addiction.
*Patti Quenzer*
Iowa City, Iowa

## A correction

*The listing of the authors in the article on the methadone controversy, "The cure becomes a new problem," was inaccurate. It should have read as follows: Henry L. Lennard, Arnold Bernstein and Leon J. Epstein. We very much regret that this error occurred.* Ed.

## *Raptors Lib*

Dear Sir: Your article, "A school opens for

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hunting birds to learn to live," is not quite as unique a venture as your readers might think. There are dozens of schools like Raptors Lib all over California.

It is ironic that falconry buffs, both pseudo and legitimate, have stirred such interest in possessing hawks, eagles and owls that nestling birds are forever being taken out of the wild. Such schools will be needed until the training and possessing of all these birds are outlawed. Techniques of the ancient art of falconry may be employed to teach the birds survival in the wild—but falconry is also causing many of these birds a life of confinement.

*J. Richard Hilton*
President, Society for the Preservation of Birds of Prey
Pacific Palisades, California

## *Phenomena, comment and notes*

Dear Sir: In your item on the book called *The Ecology of Stray Dogs,* you report that "ten times more people are bitten by the beloved dog than the hated rat." But how many people are in touch with rats every day? It's like comparing the number of kiwis that sneeze per minute to the number of calories in a rhubarb.

*Suzanne Holroyd*
Springfield, Virginia

## *Patrick Ryan*

Dear Sir: It is distressing to me, an often angler and an occasional hunter, to read such satirical personal opinion as was evident in Patrick Ryan's "Anglers' Heaven, a celestial pond." You may be of the opinion that it was just a witty piece of leg-pulling, but, let me assure you, many readers will not take it so.

*William L. Pion*
Port Clinton, Ohio

Dear Sir: Your reckless decision to publish Patrick Ryan's article on angling will no doubt invoke the wrath and abuse of those millions of fishermen who not only regard angling as sacrosanct, but also justify it with pseudoscientific propaganda.

Despite any such arguments, the fact remains that a metal barb hooked into the mouth of a fish causes pain. Certainly many thousands of people would abandon this sport if the next dumb fish they caught actually screamed in pain.

*David Hancocks*
Seattle, Washington


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# Lost colleagues and lost friends

Members of the SMITHSONIAN staff note, with a poignant feeling of personal loss, the deaths of two colleagues, Stan Wayman and Eliot Elisofon.

They were colleagues, full partners, because we consider that the illustrations (photographs or drawings) complement the words in our articles. This magazine does not often publish picture essays as such, but we value highly our graphic material.

Stan Wayman

Eliot Elisofon

STAN WAYMAN, 1927-1973

In Stan's words, "my old pappy down in the Everglades got me interested in photography when I was 12." When he got his first camera in 1940 he learned to process film, sometimes with the aid of a kerosene lantern on his father's farm. From there he went on to newspaper work and free-lancing for magazines. He joined *Life* in 1958 and the same year won first prize as Magazine Photographer of the Year. After serving in several European capitals, he returned to Washington and won seven first prizes in the annual White House News Photographers' contests.

While on part-time contract with *Life,* which he terminated before the magazine died, he found time to take a number of vivid full-page pictures for SMITH-


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ECOLOGY

**Peru.** An ecological impact study into the territorial behavior, scent communication, and alpine environment of the endangered vicuna high in the Peruvian Andes. (Limited openings.) See National Geographic Society Magazine, January 1973 article by chief scientist, Dr. William Franklin, Utah State University, April 22 - May 5, $990*.

ANTHROPOLOGY

**Botswana.** A living experience with the problems and lifestyles of the nomadic Bushmen of the Kalahari, as they struggle to adapt to a changing world. (Limited openings.) Dr. H. J. Heinz, University of Botswana, Lesotho and Swaziland. April 16 - May 4, $1290*.

**Ethiopia.** Witness and record the impact of an unexpected total solar eclipse on a nomadic people whose daily lives are governed by the movements of the moon and stars. Dr. Asmarom Legesse, Northwestern University. June 24 - July 10, $1390*.

**Kenya.** An intensive study of the animal husbandry, medicine and magic of the pastoral Pokot tribe of the Great Rift Valley of Kenya. Miss Jean Brown, University of Nairobi and ethnographer, National Museum of Kenya. July 1 - 15, $1290*.

ASTRONOMY

**Mauritania.** An expedition to observe and record the longest remaining total solar eclipse of the 20th century from the western Sahara Desert. Dr. Donald H. Menzel, Harvard and Smithsonian Observatories. June 15 - July 3. $1490*.

ARCHAEOLOGY

**Mexico.** Excavation and survey of prehistoric settlement patterns at Becan, the fortified Mayan city in the Central Yucatan Peninsula. Dr. Prentice Thomas, University of Tennessee. May 5 - June 1. $1190*.

**Israel.** Excavation of a Late Stone Age hunter's hut at Ein Gev near the Sea of Galilee. Dr. Ofer Bar-Yosef, Director, Laboratory of Prehistory, Institute of Archaeology, Hebrew University. August 19 - September 5. $990*.

**South Africa.** Survey and excavation at Makapansgat and surrounding Transvaal fossil-man caves. Dr. Phillip Tobias, University of Witwatersrand. July 8 - 21. $1265*.

MARINE ARCHAEOLOGY

**Bermuda.** Underwater expedition to excavate a 16th century shipwreck off the coast of Bermuda. CDR. Mendel Peterson, Curator, Division of Historic Archaeology, Smithsonian Institution. July 28 - August 11; August 12 - 26. $1290*.

Other 1973 expeditions: Geology in Ethiopia, Kenya; archaeology in Sudan, U.S.; astro-archaeology in Britain, Egypt; marine archaeology in Greece, Lebanon; marine biology in Florida, British Honduras; anthropology in India; ecology in Nepal.

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SONIAN, including the imaginative closing photograph for a René Dubos article (July 1972) showing Americans speeding down a scenic road and seeing nothing but a blur.

It is typical of Stan that, to prepare himself physically for backpacking 75 pounds of equipment and other necessities on a trip to Baffin Island, north of the Arctic Circle, he trained for six months on a Washington YMCA track. The result of a 40-day trek was his magnificent white wolf story in *Life* (June 2, 1967).

Just before his fatal heart attack he had gone to a specialized school to enlarge his already wide range of photographic skills. We were planning on his doing much more extensive stories for us than he had had time previously to undertake.

## ELIOT ELISOFON, 1911-1973

"To help the world to see" was Eliot's "great challenge." This challenge he met successfully in a remarkable career that included still photography, movies, writing, painting and television. SMITHSONIAN readers will remember his spectacular article on Akan gold (January 1973).

A discerning collector of African sculpture, Eliot is given credit by Warren Robbins, director of the Museum of African Art in Washington, for giving him the idea for starting that institution, which plans a memorial exhibition of sculptures from his collection.

Eliot's last three articles were for SMITHSONIAN. The first of them, the effort to restore the renowned temples of Borobudur in Indonesia, appears on pp. 18-25 of this issue. The other two, on the Smithsonian Institution project to save the Gir lions of India and the meaning of Japan's traditional costumes, will be published later. Just a few days before his fatal cerebral hemorrhage, Eliot was in our office, in high spirits at the results of his trip.

I had the privilege of introducing several of Eliot's friends at the memorial service for him. I said, in conclusion: "He worshipped beauty—in art and nature. . . . He worshipped the intuition and precision of his professions. He worshipped the many manifestations of the human spirit."

There are other great photographers and there will be more, whose work you will see. But now we are mourning two friends.

—Edward K. Thompson, Editor

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Prairie Dog Village, 1860
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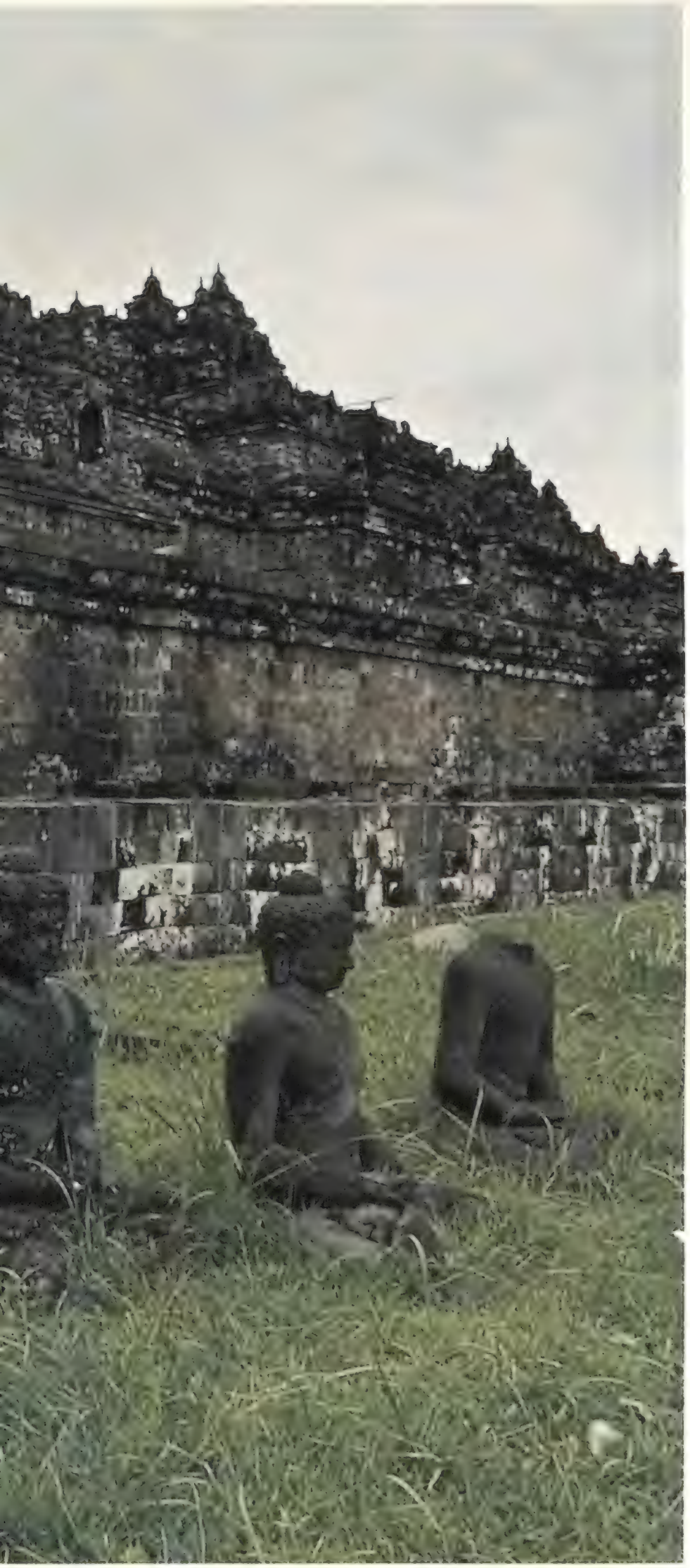
Rising like a massive mountain of carved stone, Borobudur once had more than 500 Buddhas along its walls. These Buddhas—many decapitated by vandals—have been removed and await restoration.



*Photographs and text by Eliot Elisofon*

# An eleventh-hour effort to save Java's Borobudur temple

*One of the world's great monuments will be gone unless it is rescued from volcanoes, algae, monsoons and vandals*

Atop a hill in the Diëng Plateau of central Java lies Indonesia's most imposing monument of architecture and sculpture. Known as Borobudur, this thousand-year-old Buddhist temple is the magnificent heritage of the Sailendra dynasty that ruled over Sumatra and Java from the 8th through the 13th centuries.

Today Borobudur is in trouble. The monument may look serene and majestic, amid its setting of rice paddies and volcanoes, but it is falling victim to a variety of calamities. The earth tremors created by a still-active volcano and the yearly monsoons have caused the hill on which Borobudur was built to slowly erode. The stones of the temple are afflicted with a "rock disease"—a combination of lichen, fungus and bacteria that is eating away the bas-relief sculpture. Unless large-scale restoration work is begun immediately, Borobudur's decline is irreversible.

Like the Tower of Pisa, Borobudur proved to be structurally insecure even before it was completed. Built around a core of rubble and packed earth, the temple was of such massive weight that its meager support was inadequate. The original base of the monument, covered with bas-reliefs, was sacrificed by the builders, who shored up the structure by adding more stone around the bottom. We know this because some of the reliefs were left unfinished.

*The late Mr. Elisofon had been a contributor to* SMITHSONIAN *since 1970* *(see p. 16).*

*Borobudur in peril*

The historian Arnold Toynbee ranks Borobudur with the Parthenon, the Taj Mahal, the church of Hagia Sophia in Istanbul and the Sainte-Chapelle in Paris. Borobudur is certainly a great monument, although there are others who would not agree with this ranking, myself included. Borobudur does not compare to its nearest neighbor in this panoply of great monuments, the complex of temples in Cambodia's ancient city of Angkor, of which Angkor Wat and the Bayon are the most spectacular.

Still, Borobudur merits preservation. There are plans to dismantle the temple and reconstruct it on a concrete platform, but this will cost millions of dollars. Moreover, this restoration must be done before the volcano Merapi (Fire Mountain) erupts again, creating earth tremors that could topple the structure.

Borobudur is a many-storied, stepped pyramid of gigantic proportions, constructed on a base measuring about 375 feet on each side. A steep central stairway on each side leads directly to the great stupa of the monument, which is approximately 130 feet above the ground. Each story is a notched square in plan and is edged with balustrades, creating narrow corridors that are open to the sky. There are no interior corridors, and, in fact, no "inside" to the temple at all. Prayer here took place in the glaring sun.

The main walls as well as the balustrades are covered with a seemingly endless succession of bas-reliefs (several miles of them!), all carved in volcanic stone and constituting a pictorial narrative of the sacred legends of Buddhism. On the lower three galleries alone, there are 1,460 scenes, illustrating the life of Buddha and various Buddhist texts.

Borobudur represents a microcosm of the universe as it was imagined in the Mahayana Buddhist theology. As a symbol of the Buddhist universe, Borobudur is subdivided vertically into three "spheres." There are six terraces or galleries, each contained by a decorated wall. The bottom three represent *kāmadhātu,* where man is still shackled to greed, a stage at which man is concerned with worldly wealth. The second group of three represent *rūpadhātu,* where man has freed himself from passion but is still not pure.

The top of the temple has three circular terraces, stacked concentrically one on top of the other. Each of the terraces is ringed with small, bell-shaped stupas, of which there are a total of 72. Inside each stupa is a life-sized stone statue of Buddha in the attitude of meditation; these can be glimpsed through the openings in the patterned stonework. There are no bas-reliefs on these uppermost levels, only utter simplicity, and it is meant to represent *arūpadhātu,* the complete perfection of man.

Borobudur is only the most spectacular example of Java's religious architecture. Beginning in the early decades of the eighth century, the Javanese began building untold numbers of *tjandis,* a type of religious edifice, in a variety of locations, from open plains and valleys to the slopes of mountains. One could say that the island literally had a construction boom that lasted into the middle of the tenth century. This epoch is now known as the Central Javanese Period, which is not an especially appropriate term as many of the temples were built on the eastern part of the island.

Each of the bell-shaped stupas on top of the temple enshrines a seated Buddha. The stupa in the foreground has been dismantled, exposing the Buddha.

The original base of the temple was covered with bas-reliefs, but the builders concealed them by shoring the structure with additional stones. These walls, on one of the galleries, are tilted almost to the buckling point. They could be brought down by volcanic earth tremors.

These Buddhist temples were the product of a Hindu-Javanese culture which had parallels in other parts of Southeast Asia. The Indonesian archipelago was swept by crosscurrents of foreign cultures, particularly from India. Java and Sumatra were popular stopping-off points for traders and monks. Old written records from China indicate that Chinese Buddhist pilgrims visited Indonesia en route to or from India.

The two great religious systems of India, Hinduism and Buddhism, were introduced at an early date, and with them came the Sanskrit language, as well as new social, political and technological ideas. Yet it would be erroneous to say that Indonesian culture was based entirely on foreign cultural influences, because the Indonesians can lay claim to an indigenous cultural heritage that is datable all the way back to the neolithic period, when they were already building megalithic monuments.

If more artifacts had survived, we might know more about the sources of the so-called Hindu-Javanese culture. But Indonesia's hot and humid climate is not conducive to the preservation of art. Borobudur's basreliefs show men carrying rolls of scriptures or paintings, and a pair of lovers exchanging portraits, so there is evidence of the completely vanished art of painting. Also, it is probable that many of the magnificent stone statues had gleaming counterparts in bronze.

The end of the Central Javanese Period is just as obscure as the beginning. Nobody really knows what happened to the sophisticated civilization that built Borobudur. All construction in central Java seems to have ceased at the beginning of the tenth century. Because some of the temples were left unfinished, it is thought that a natural disaster—a volcanic eruption or an earthquake—triggered a sudden shift of the population to eastern Java. The Buddhist sanctuaries were deserted and over the next centuries became increasingly derelict as rains, earthquakes and tropical vegetation played their part. During the 13th and 14th centuries a new religion, Islam, was introduced to Java and it eventually replaced Buddhism as the island's religion. So the decaying Buddhist sanctuaries were no longer considered sacrosanct.

Borobudur survived to be rediscovered and resurrected in the 19th century by Dutch merchants of the East India Company. While the Dutch can take credit for most of the restoration, it was the English lieutenant governor, Sir Thomas Stamford Bingley Raffles, who first ordered a military engineer to clear the monument of the earth and trees that had almost covered it; that initial clean-up operation was completed in 1816. Another restoration was made by the Dutch during 1907-1911, when some of the walls on the north side were sagging. This is still the area where the greatest change is taking place. Of course there were some mistakes. A Dutch archaeologist from Leiden

This serene-looking head, with the spiraling curls and long earlobes that are characteristic of Buddha, has been completely cleaned and restored.

A West German restorer, sent to Indonesia by UNESCO, puts the finishing touches on another head that he has reassembled from 14 separate pieces.

University painted many of the reliefs with ocher in 1911 to improve his photography. This yellow color remains on parts of the panels in spite of the rains.

Like most monuments, Borobudur has been looted many times. Many of the magnificent statues of Buddha—originally there were more than 500 in niches along the walls and galleries—have been decapitated, their heads sold in the world art markets. The Dutch actually gave to Chulalongkorn (1853-1910), the visiting King of Siam, eight wagonloads of statues and bas-reliefs, which included five of the best Buddha figures and the only two complete lions. (Chulalongkorn is best known to Westerners as Rama V, the Yul Brynner character in the Rodgers and Hammerstein musical *The King and I*.) There is probably as little chance of these stones coming back to Borobudur as there is of the British Museum returning the Elgin marbles to the Parthenon.

If Borobudur is to be saved, two great problems must be overcome. The first problem is terrain. Borobudur is on a low hill. A gradual slide down the hill would finally topple the whole structure and, as noted, there is particular danger from Merapi, the active volcano that is some 20 miles away from Borobudur.

The second great problem is the gradual destruction of the stones by a mass of algae, fungi, lichen, moss and other botanical growths. The most revolting of these are the algae which resemble a wet, black scum. The lichens are brown and strong enough to break away the surface decoration of the rock. The fungi vary from white to black and look like multiple birthmarks on the divinities. Many of the soft stone bas-reliefs are rapidly disappearing. To study the actual changes, I made some photographs early this year of panels which I had recorded during an earlier visit in 1967. One of the most beautiful panels, showing Buddha being tempted by the wives of Mara, has a slightly heavier encrustation, and the cracks between the

stones seem to be increasing. But six years is a small span of time in the life of a shrine that has endured a thousand years.

The chief villain in this tragedy is the heavy rains which beat upon central Java each year. What is happening is that the water filters through the monument to the hill upon which it sits, and then seeps back through the temple stones, carrying with it salts it has extracted out of the ground. These encourage the botanical growths; also, the water has pushed some of the stones out of position by eroding the support below.

A last-minute effort is now being made by UNESCO and the Indonesian government to save Borobudur. In 1971 the Indonesian government and an ad hoc committee of international experts approved a plan, prepared by consulting engineers, to stabilize the foundations of the monument. The plan is to dismantle the lower terraces and balustrades of the monument. The engineers will then construct reinforced-concrete "shelves," which will serve as a sort of watertight raft, "floating" the monument and making it relatively invulnerable to earth tremors. The restorers will introduce an improved system of drainage to reduce the effects of weathering. Finally, they will clean and reassemble the individual stones.

In addition, all the stones will be treated with a liquid sealing agent combined with a biocide to kill the present growths. A chemical laboratory at Borobudur is now testing combinations of these agents, as well as bitumen or tar which would be painted on the backs of the stones before reassembly to render them waterproof. A West German restorer is now at Borobudur, courtesy of UNESCO, teaching the Indonesians how to mend broken statues. When I was there, he had just finished putting together a Buddha which had been broken into 14 pieces.

The total cost of preserving the temple is estimated at $7,750,000. Indonesia has promised UNESCO that it will provide $2,750,000 if the international community will donate the remaining $5 million. But the Indonesian government has agreed to undertake the necessary work only if the total pledged by UNESCO's member states and associate members has reached the equivalent of $3 million by the end of this month. So far UNESCO has received more than $2 million in pledges or contributions. (In the United States, a committee of private citizens is being organized to raise an additional $500,000.) René Maheu, the Director-General of UNESCO, has appealed to the member states to unite again, as they did in the case of Egypt's Abu Simbel and Philae, "to save this admirable work, whose disappearance would impoverish all men."

A team of Indonesian engineers, equipped with surveying apparatus, measures the eastern facade. In the background, tourists climb the stairway.

This gargoyle, which disgorges rainwater from one of the lower galleries, is afflicted with a scurfy-looking assortment of botanical growths.

# How we democratized the American diet from salt fish to frozen berries

*A late 19-century breakthrough in preserving, condensing and transporting food eventually brought a millionaire's delights to many palates*

The flavor of life on the U.S. frontier came from winter's cold, summer's heat and the special taste and color of each season's varying diet.

In November 1846, the Donner party of 87 emigrants on their way from Illinois to California were trapped in deep snow and would all have starved to death had not the survivors sustained themselves by eating the flesh of those who had died. For practical-minded Americans of the day this was not only an episode in the history of American morals; it also dramatized the peculiar needs of Americans on the move.

When Gail Borden, a surveyor and land agent at Galveston, heard of the starvation of the Donner party and the hunger of others who were trying to cross the continent, he was stirred to invent a way of making food more portable.

Born on a farm in central New York, he had meandered west with his parents, first to Ohio, and then on to Kentucky and Indiana. He personally knew the problems of westward travel. He taught himself surveying, then earned his living as a schoolteacher, started a newspaper and, when he settled in Galveston, was known locally as an inventor. His wedding present to his wife was his homemade revolving dining table, with a fixed rim the width of a dining plate, and a revolving center on which the dishes to be served could be rotated to each person. "He has dozens of inventions," a Galveston neighbor observed, "and he is the most wonderful of them all himself."

He tried to concoct a new kind of portable food for friends who were traveling to California in July 1849, and made an "important discovery . . . an improved process of preserving the nutritious properties

Adapted from *The Americans: The Democratic Experience* © 1973 by Daniel J. Boorstin

*By Daniel J. Boorstin*

of meat, or animal flesh, of any kind, by obtaining the concentrated extract of it, and combining it with flour or vegetable meal, and drying or baking the mixture in an oven, in the form of a biscuit or cracker."

Borden spent years (as his biographer, Joe Frantz, recounts) developing his meat biscuit and trying to secure its acceptance by physicians and by the United States Army. But the powerful suppliers of fresh meat to the army made it difficult for it to get a fair trial. When people complained that Borden's biscuit was "unsightly" and unpalatable, Borden himself confessed that he alone really knew how to prepare his biscuit. Frederick Law Olmsted on his travels through Texas finally fed his to the birds, declaring that he would "decidedly undergo a very near approach to the traveler's last bourne, before having recourse to it."

Even before the meat biscuit failed, Borden had turned to an idea which before the end of the century would make his name a synonym for milk.

On a rough ocean voyage back from the London Great Council Exhibition in the fall of 1851, one story goes, cows in a ship's hold became so seasick that they could not be milked. When Borden, a passenger, heard the hungry cries of immigrant babies, he began to wonder whether he could not somehow use his condensing technique to provide milk for such emergencies. Luckily, he did not know enough to be confused

*Dr. Boorstin, currently director of the Smithsonian's Museum of History and Technology, will resign in October to become Senior Historian. His prize-winning histories,* The Americans: The Colonial Experience *and* The National Experience, *are followed by next month's Book-of-the-Month Club choice,* The Democratic Experience (*Random House*).
*A section of the book has been adapted for this article. Drawings are by the late Baltimore artist Dill Cole.*

"People found Borden's biscuit 'unsightly' and Frederick Law Olmsted . . . fed his to the birds," saying he would " 'undergo a very near approach to the traveler's last bourne, before having recourse to it.' "

by the theories of the day, all of which proved that it couldn't be done. He simply tried his own hand.

First Borden boiled milk in an open pan on a sand bath heated by charcoal, and then he added brown sugar. When the resulting liquid was sealed in glass, it would keep for months but it had a dark color and smelled like molasses. At the Shaker Colony in New Lebanon, New York, where Borden first saw a vacuum pan, he obtained one and with it tried condensing milk. But as the milk was heated, it stuck to the side of the pan, then foamed and boiled over. Experts advised him to give it up, but Borden merely greased the pan, and in that remarkably simple way perfected his technology of condensing milk.

Even before his condensed milk had found a market, Borden was trying to condense coffee, tea and "other useful dietary matters." Condensing became his obsession. "I mean to put a potato into a pillbox, a pumpkin into a tablespoon, the biggest sort of a watermelon into a saucer. . . . The Turks made acres of roses into attar of roses. . . . I intend to make attar of everything!"

Condensed milk quickly proved to be a commercial success. The milk then commonly distributed in the city was called "swill milk" because it came from city cows fed on the "swill" or residue from distilleries. It contained almost no butterfat, and to cover up its unsavory blue it had to be artificially colored. Manure and milk were hauled in the same wagons, and Frank Leslie's *Illustrated Newspaper* told tales of sick cows propped up for a last milking before they expired. The city swill-dairies were a kind of "Vesuvius which belched forth intolerable and stinking stench."

Borden's dairy-fresh sanitary product set a new standard of quality. He sent his inspectors to instruct farmers. He took no milk from cows that had calved within 12 days, and he required that udders be washed in warm water before milking, that barns be kept clean and that manure be kept away from the milking stalls. He demanded that the wire-cloth strainers be scalded and dried morning and night. Inspectors at the factory rejected milk that arrived with a temperature above 58 degrees. In many ways this complicated the lives of farmers, but it simplified their lives, too. For Borden had turned the dairy farmer into a milk wholesaler who no longer had to peddle his milk, or churn butter or mold cheese.

When the Civil War broke out, Borden was ready to supply the army. One of his sons was fighting for the Union, the other had joined the Texas cavalry on the side of the Confederacy. But the Union Army bought Borden's condensed milk as a field ration, and Borden himself was committed to the Union.

Even after his New York plant was turning out 14,000 quarts a day, he still could not keep up with the government orders, and so he licensed plants in other parts of the country. By the end of 1866, the Elgin, Illinois, plant alone was purchasing from farmers nearly a third of a million gallons of milk each year.

"Condensing became [Borden's] obsession. 'I mean to put a potato into a pillbox, a pumpkin into a tablespoon, the biggest sort of watermelon into a saucer. . . . I intend to make attar of everything.' "

When the soldiers dispersed at the end of the war, they advertised Borden's products all over the country.

While Borden was finding ways to condense milk and put it into a can to be kept indefinitely, scores of other enterprising Americans were finding ways to bring everything to everybody year-round. The basic process of canning had been invented by a French winemaker and food supplier, François Appert, who won a prize from Napoleon in 1810 for finding a new way of supplying fresh provisions for the French navy. Appert had invented the cooking and sealing process which produced a flourishing canning industry in 19th-century Europe and, with a few basic improvements, continued in use into the 20th century.

In the 1840s the American canning industry gained momentum. Corn, tomatoes, peas and fish were canned for travelers journeying to California. Baltimore, on Chesapeake Bay where the oysters, crabs and fish were plentiful, became the first great American canning center. The Civil War added impetus, and in the decade after 1860 the number of cans of food put up annually rose from 5 million to 30 million. Many men had their first taste of canned foods in army camps, on gunboats and in hospitals, and when the army dispersed, they carried the word.

Large-scale canning required containers by the thousands. Appert's original process for "canning" was actually a scheme for preserving food in glass containers. About the same time an Englishman had patented a technique for preserving food in tin. But cans were still fashioned by hand, and a tinsmith could make only 60 in a whole day. Then, during the middle of the 19th century, Americans improved tin cans and made machinery to turn them out by the thousands—stamping out tops and bottoms, soldering the joint on the side, crimping and sealing the top.

By the 1920s more than a billion-and-a-half pounds of tinplate were annually being made into cans. The tin can had begun to play its role, helping the American housewife and cluttering the American landscape.

### *Meat on and off the hoof*

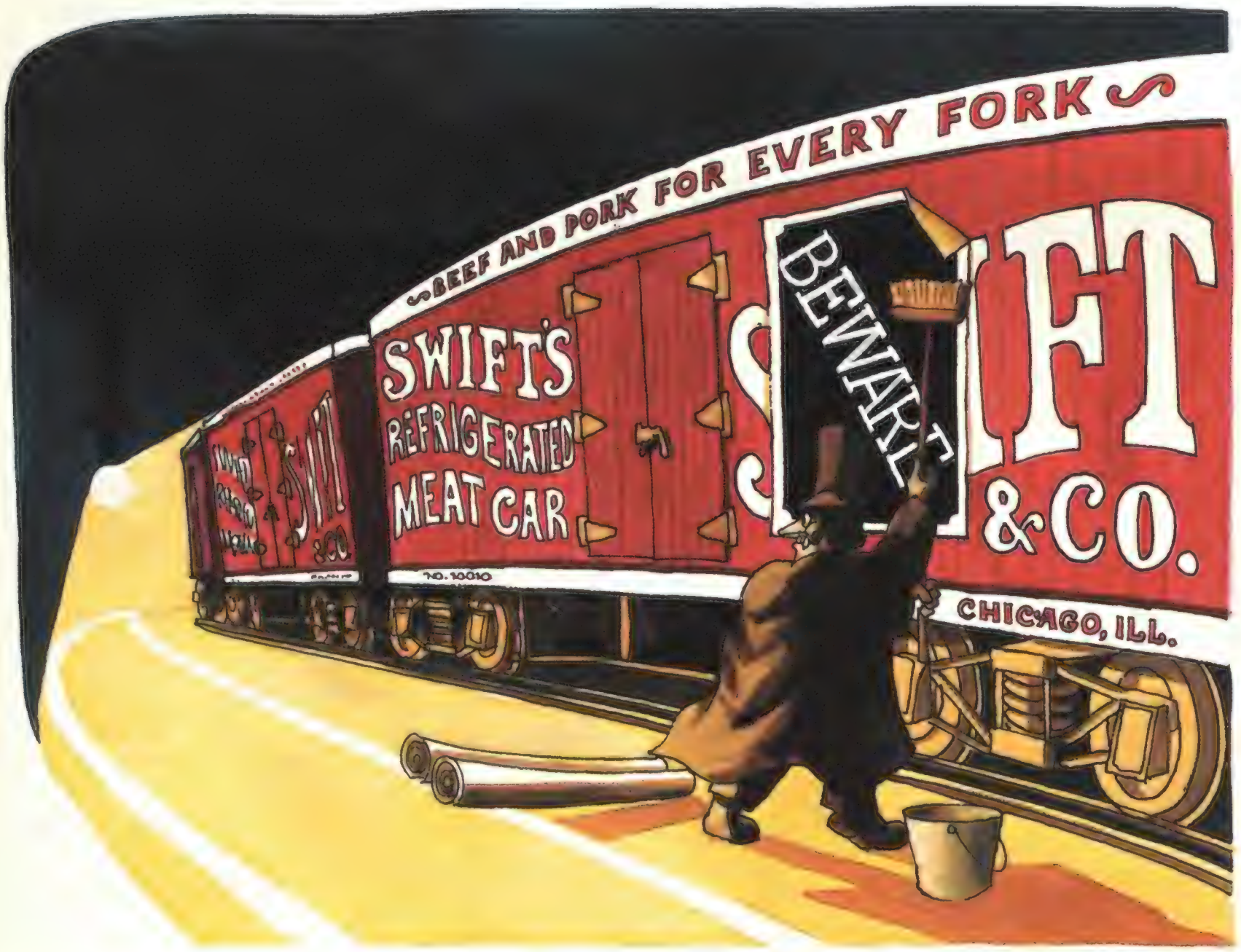
Before the Civil War, fresh meat for the city dweller came on the hoof. Each city had its slaughterhouses which produced piles of offal and an offensive odor. For long-distance shipment, meat had to be preserved by salting and smoking and then be packed in barrels. Fresh meat was available only at certain seasons and remained costly. The social class and income of an urban American could be gauged by the quantity and quality of fresh meat found on his table. There is no better illustration of the American paradox —of how the very extent of the nation encouraged the finding of new ways to make life more uniform— than the story of meat. For there came into being a national, even international, market for fresh meat raised on the Western plains.

To extend the market for fresh meat, there had to be a practical refrigerator car. Then meat-packers in the West could do their own slaughtering for the fresh-meat market in Eastern cities. By shipping dressed beef they could save freight on the 35 percent of the animal's weight that was unsalable. Incidentally, they would save the cost of feeding live cattle in transit and avoid loss of weight, and sometimes of whole animals from overcrowding. Naturally enough, the railroads, with their large investments in loading docks and feeding stations for live cattle, feared the refrigerator car. In Eastern cities, local butchers and slaughterers spread propaganda against the "poisonous" meat that had been carried for long distances on the rails. The railroads charged an especially high rate on dressed meat so that it would yield them as much profit as if the animals had been shipped on the hoof; they could hardly have been expected to take the initiative in building refrigerator cars.

The stage was set for a go-getter to organize railroad refrigeration and bring fresh meat to the growing Eastern cities. The leading roles were played by two Americans, a Swift and an Armour who, like Borden, became household names in every corner of the continent and in the far corners of the world.

Gustavus Franklin Swift at the age of 14 went to work for his brother, the village butcher in the village of Sandwich on Cape Cod. He entered business for himself when he had enough money to buy a heifer, which he slaughtered and sold as dressed meat from door to door. He started to deal in cattle and gradually moved westward with the cattle market, from Cape Cod to Albany, then to Buffalo, finally to Chicago in 1875. He began to imagine how much more beef could be sent from Chicago if only it could be slaughtered and dressed before shipping.

There had been occasional shipments of this sort,




"Eastern slaughterers spread propaganda against the [suspect] meat that had been carried for long distances on the rails."

but they were always in winter when cold weather kept the meat from spoiling. Swift foresaw a year-round trade. Risky as that seemed, he had the advantage of knowing the New England meat business.

He finally turned to the Grand Trunk of Canada railway, which agreed to carry refrigerator cars if Swift himself would provide them. Swift invested his capital in ten new refrigerator cars and by 1881 had perfected one that would deliver Chicago-dressed meat fresh to the Eastern butchers. When the railroads saw that carrying dressed beef might actually increase their business, they began to compete for the traffic. The Eastern butchers, too, now saw their chance to sell more meat, and several actually went into partnership with Swift.

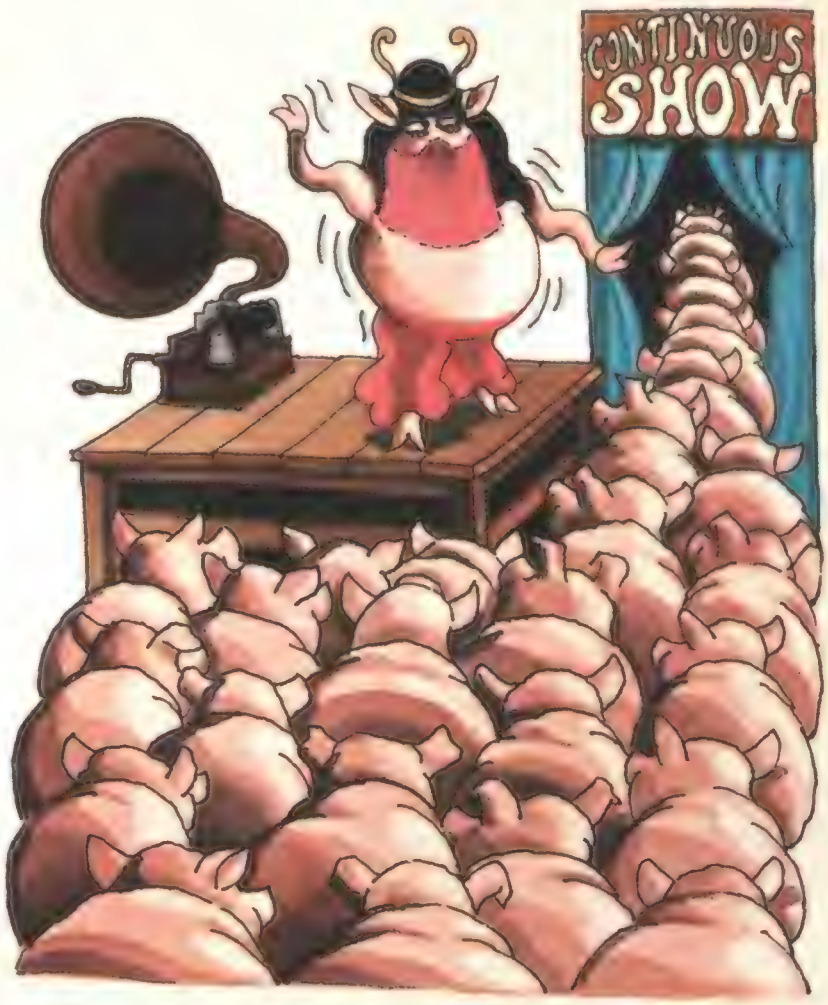
After collecting his cattle in Chicago, Swift had to devise a way to slaughter them quickly for loading into his refrigerator cars. To avoid the need to transfer the meat from one car to another en route, the cars had to be sent over railroad lines of a common gauge, and in the 1870s that required planning. To avoid spoilage when the refrigerator car arrived, it had to be brought to a halt with its doors precisely opposite those of a cold-storage building. Then the overhead rails which Swift had constructed inside each car, and on which the sides of meat were hanging, were connected to those within the building.

*Swift's "Disassembly Line"*

This was only a step in an organization that reached back to slaughtering and finally to cattle-producing, and forward to the world of consumers. To get the most out of the carcass of a hog required the invention (in Sigfried Giedion's phrase) of a "Disassembly Line." Experience in disassembling hogs would prepare the way for Henry Ford's new way of assembling automobiles. The slaughtering of the hog and the cutting of the carcass were broken down into numerous operations. The most difficult problem was how to get the live hogs into the production line, for each tended to go its own way. The solution was to use one live hog as a decoy: When it was penned on the moving disassembly line, the other hogs followed in good order and in a posture where they could be snagged and hoisted for the slaughter.

Swift had a genius for this kind of organizing. He organized the slaughtering so that parts that were formerly discarded could be made into brushes, oleomargarine, glue, pharmaceuticals and fertilizer. He spread his production centers westward to Minnesota and Nebraska, southward to Texas. He began selling dressed meat in France and England and crossed the Atlantic 20 times to perfect these arrangements; he then added distributing branches in Tokyo, Shanghai, Hong Kong, Honolulu, Vladivostok and Constantinople. By 1912 Swift and Company, employing more than 30,000 men and women, had outlets in 250 cities on four continents. Swift had built a new giant industry in response to peculiarly American opportunities—vast spaces and the extreme contrasts between newly congested cities and still empty prairies. Space and contrast offered openings for organization.

The enterprise of Swift was matched by that of Philip Danforth Armour, who had been raised in New York. With money he had made in the California




"The solution was to use one live hog as a decoy . . . the other hogs followed in good order and in a posture where they could be snagged [for] slaughter."

Gold Rush, Armour entered the grocery business, then went into meat-packing. In the last days of the Civil War, when pork was selling for $40 a barrel and going up, Armour foresaw that a Union victory would soon bring pork prices down. He went to New York to sell pork futures and found many takers. When Union victories sent pork prices plummeting, Armour was able to buy for $18 a barrel pork which he had already sold for more than $30. So he was well rewarded for his patriotic confidence in the Union.

The two million dollars Armour made on this deal

became the foundation of his meat-packing fortune. Armour, like Swift, came to Chicago in 1875, and thereafter their careers were remarkably parallel. Armour, too, pioneered in organizing slaughterhouse "Disassembly Lines," in finding uses for every shred of the carcass and in constructing refrigerator cars. His reputation, like Swift's, was not improved by the scandal of "embalmed beef," a supply of bad beef sent to the troops in the Spanish-American War. But Armour and Swift both became generous philanthropists.

The market for fresh meat which was rapidly increased by refrigeration was matched by a similar increase in the market for preserved meat. Now the most popular mode of preservation was no longer salting, spicing or smoking, all of which had been known from ancient times, but was canning. However, ingenuity was required to adapt the can to the peculiar requirements of meat.

At first, meat which was packed in ordinary cans always came out as stew. Then a new process was used for cooking the meat before it went into the can, so that there would be no shrinkage. And another clever Chicagoan, J. A. Wilson, designed a can shaped like a truncated pyramid; when the housewife opened the can at the larger end, as the instructions explained, a tap on the other end "will cause the solidly packaged meat to slide out in one piece so as to be readily sliced."

Since canned meat did not require refrigeration, fewer refrigerator cars were needed to transport the output of the slaughterhouses. And the great Chicago packers, who by then had invested heavily in refrigerator cars for shipping meats, went desperately in search of products that could use their expensive equipment. Armour sent agents South to encourage the raising of large quantities of perishable fruits and berries that would require refrigerated shipping to Northern cities. In Georgia, for example, his agents encouraged the growing of peaches for rail shipment to the North.

Until after the Civil War it was widely believed that all foods had the same nutritive value. There was supposed to be one "universal aliment" which helped the body grow, which kept it warm and working, and repaired the tissues. This popular notion justified the monotony of the popular diet. When men called bread "the staff of life," they were not just being sententious.

Nourishment was measured by quantity: The poor suffered not because they ate mostly bread but because they did not have enough bread. Seafarers knew that to prevent scurvy they should eat fresh fruits, but these were considered more medicinal than nutritive.

"When the housewife opened the can at the larger end . . . a tap on the other end 'will cause the solidly packaged meat to slide out . . . to be readily sliced.' "

In the 18th century, although a monotonous diet marked the lower classes, variety of food was a delight, a dissipation and a privilege of the wealthy. Patrick Henry accused Thomas Jefferson of an effete taste for "French cookery." In the "Log Cabin" campaign of 1840, the Whigs boasted that their candidate William Henry Harrison lived on wholesome "raw beef without salt," while his aristocratic opponent Van Buren was alleged to luxuriate in strawberries, raspberries, celery and cauliflower. "Democratic" enthusiasm at first made a virtue of crude and tasteless food, and obsession with the delights of the palate was considered a symptom of Old-World decadence.

"By the 1920s the mechanical refrigerator was beginning to become an essential piece of furniture in the American middle-class kitchen."

"While ice-fishing in Labrador, when the temperature was 20 below zero, [Birdseye] pulled in a fish and dropped it beside the hole. It quickly froze."

A few independent spirits like John Adams said that American suspicion of French cookery was a mere relic of Colonial prejudice and so belonged to the past. And in the 1830s young ladies invited out to dinner, who wanted to impress their escorts, would request that their vegetables be served "in the French manner," which meant each vegetable in a separate dish. They could show their sophistication by saying that it somehow took their appetite away to see all their foods jumbled together on one plate in the familiar American manner. But until about the time of the Civil War, a varied, well-flavored diet was generally reserved for those who could afford an expensive meal in one of the few new, elegant restaurants.

*Delmonico's, and the joy of eating*

Among the best of these restaurants was Delmonico's in New York City. In 1832, at the age of nine years, Lorenzo Delmonico had arrived from the Italian-speaking Ticino in Switzerland. Delmonico imported recipes and cooks from the best kitchens of Europe, but he also helped Americans discover delicacies in their own backyard. European travelers were astonished at the American specialties of fish, game and meat at Delmonico's. One of his achievements was to help Americans discover salads. He popularized ices and green vegetables. Few did more than Delmonico to educate the American palate.

In the 1830s and 1840s there was a widespread suspicion that fresh fruits and vegetables were dangerous to health and especially detrimental to children. Uncertainties about the causes of dysentery, typhoid, cholera and other epidemic diseases made these fears more plausible. But within 50 years the United States had organized a nationwide, soon to be worldwide, trade in fresh fruits and vegetables. The diet of the common American citizen was more varied than that of many a European of wealth. Diet had become democratized.

Railroads naturally enlarged the supply of fresh fruits and vegetables. In the 1840s the Camden and Amboy Railroad, which went through the "Pea Shore" garden region of New Jersey, ran a special express train, known as the "Pea Line," to pick up farmers' produce for New York City. By the 1860s New Yorkers were eating produce shipped from the truck gardens around the new rail center of Norfolk, Virginia, and an enterprising merchant in Chicago imported green peas from New Orleans at $8 a bushel.

Before about 1875 the people who lived comfortably in cities preserved their own summer perishables for winter use. Apples, potatoes and some other fruits and vegetables, mostly of local origin, were bought in season and then stored in the family cellar. Then two

## *Democratizing our diet*

great changes in city living made such storage harder. One was central heating, which made cellars too warm for cold storage. The other innovation was the apartment house, a by-product of the higher land values which had come with the crowding of the cities. The apartment dweller usually had no cellar at all.

These money-making opportunities for the dealer in fresh produce assured the farmer of a ready, regular market for all his produce. Before, by growing early and late varieties of the same fruit, and by several plantings, he might have something fresh to sell to the local market over most of the months. "Carrying-quality," not to mention such fine points as appearance, taste and texture, did not enter much into the farmer's calculations. But the refrigerator car and the refrigerator ship changed all this. Now the farmer could devote his land to the one variety that best survived shipping and at the same time was attractive and tasty. And by 1875 Luther Burbank, "the farmer's Edison," was applying his genius to developing still more desirable and marketable varieties.

Instead of looking for streams and rocks that would yield gold or silver, enterprising Americans, in an increasingly urban America, were seeking soils and climates to grow perishable crops to ship to remote parts of the nation. Exuberant land-promoters directed their advertising to the ambitious farmer.

Before World War I, pioneer fruit and vegetable growers had staked out their new orchards and truck farms all over the country. Irrigation was producing cantaloupes, watermelons, lettuce, asparagus and tomatoes in the Imperial Valley of California and the lower Rio Grande Valley of Texas on the Mexican border. Land that only a few years before had been scorned as desert was now supplying city dwellers in Boston and New York, in Chicago and San Francisco, with exotic fruits.

As the number of city dwellers increased and as they worked shorter hours and became more sedentary, the demand for starchy, energy-producing foods was replaced by one for fruits and vegetables. Motor trucks and refrigerator ships distributed perishable foods far beyond the rail network. New Yorkers, by the 1930s, were buying fruits and vegetables from 42 states and 19 foreign countries.

At the same time, another step was being taken toward homogenizing regions and seasons, toward democratizing the national diet and increasing the variety of foods of the ordinary citizen. Refrigeration was brought to almost every household. Enterprising New Englanders like Frederic Tudor and Nathaniel Wyeth had built a thriving ice trade well before the Civil War. But until 1830 ice was used mainly for ice cream or cold drinks on the tables of the wealthy. The word "icebox" entered the language by the time of the Civil War, but ice was still just beginning to affect the daily diet.

Yet mechanical refrigeration developed only gradually, having been made possible by the discoveries of Lavoisier, Faraday and other European physicists. The Americans discovered no new principles but showed their talent for application. By the 1920s the mechanical refrigerator was beginning to become an essential piece of furniture in the American middle-class kitchen.

Many would have thought that there was little more to do to equip the American for a nearly uniform year-round diet. But Clarence Birdseye was so successful in improving the taste and nutritive value of storable foods that before his death people assumed "Birdseye" was the name of a product, not of a person.

### *Quick freezing preserves cell walls*

Birdseye was a naturalist of Gloucester, Massachusetts, who had been looking for better ways to preserve fish. While ice-fishing in Labrador, when the temperature was 20 below, he pulled in a fish and dropped it beside the hole. It quickly froze solid. Birdseye took the fish home, and when he put it in a pail of water, he found to his amazement that the fish started swimming. The explanation, as he later discovered, was that the cells of the fish had been frozen so quickly that there was no time for the formation of the large crystals that would have broken the cell walls and killed the fish.

Birdseye's quick-freezing process was first applied to seafood. Later it was found that pre-cooked foods could be frozen and sold ready to heat and serve. By 1972, one household in three had its own deep-freeze unit, and few American homes lacked a place for the storage of frozen foods.

Today's Americans feast souls as well as stomachs,
no matter the time or place, on packages of instant joy.

*Text and photographs by John Reader*

# Waterfowl teem in a protected Kenyan preserve

*Armed with such implements as water pistols, biologists seek the key to conserving some of the world's ornithological wonders*

Daphne (right) and helper prepare to release pelican which is marked with yellow identification tags.

When 24-year-old Daphne Nightingale waded into the alkaline waters of Lake Nakuru with a stuffed pelican on her head, she was able to approach within 25 yards of some pink-backed pelicans. These birds grouped into a flotilla and cruised up and down like ships of the line, beadily eyeing her lopsided headdress (opposite). Daphne observed them meticulously through a peephole cut in her stuffed pelican's breast.

Daphne is studying the behavior and ecology of the pelican populations of Lake Nakuru, an ornithological wonderland that is home for some 400 bird species, including a million or more flamingos (see cover). She is almost through her 18-month study for a master's degree and has undertaken to produce a detailed study of the pelicans' social and feeding behavior and their migratory patterns.

Earlier Daphne had carried within her stuffed pelican a battery of water pistols charged with colored dyes. To follow individual movements she must—naturally—be able to recognize individuals; she hoped to mark them with indelible red, blue, yellow and green dyes. But she failed. No birds allowed her within pistol-squirt range. Later she tried hurling those delicate glass balls one hangs on the Christmas trees at the pelicans (again charged with dyes), but to no avail.

Next she experimented with a crossbow, the bolts tipped with a dye-saturated sponge, but before she could bring this weapon to bear upon the pelicans, Nairobi University (to which Daphne is attached) acquired a rocket net. With the help of the net she has caught, weighed and measured 42 pelicans, each of whom now has a pair of numbered red, green, blue or yellow disks fixed to its wings. Several times a week Daphne tours the lake, plotting the position and grouping of her marked birds.

Two species of pelican frequent Lake Nakuru, the white and the smaller pink-backed. They are not difficult to tell apart, the white being mostly white and pink and the pink-backed predominantly gray.

Currently there are nearly a hundred scientists in East Africa working on wildlife research projects, spending days, months, even years, in diligent observation and in recording of data.

Of facts there are many. Some seem little more than fascinating curiosities. One may ask if it is really necessary to know that pelicans may spend six or more of

Still wearing her portable, stuffed-pelican blind, biologist Daphne Nightingale trudges through the mud after closely observing a flotilla of pelicans.

the daylight hours roosting and that they will spend 50 percent of this time preening themselves, meticulously going over every feather with either bill or foot. Surveying the welter of knowledge accumulated during the brief period that scientists have been studying animals in the wild, one has the overwhelming impression that there are hundreds of jigsaw puzzles, each with a thousand pieces, all of them jumbled together in a box that is the East African environment. Meanwhile there is the clamor for conservation.

With so many facts and so much knowledge available it seems absurd that so little appears to be being done; the trouble is that there is precious little coordination or collation of individual material. Studies need to be continuous and interrelated, with the prime aim of establishing a sound baseline of scientific fact for management programs rather than merely providing the material for an individual's Ph.D. thesis.

So, one might say that wildlife scientists have barely fallen into stride in looking for answers to conservation and management problems; however, now and then—as though to reaffirm good faith—a fact pops up out of the jigsaw box that is in itself an answer. This is yet to occur at Lake Nakuru.

Lake Nakuru is 5,767 feet above sea level. By night the temperature may fall near freezing (this writer spent a night camped there when the minimum was just about 40 degrees Fahrenheit). By day the sun's heat is intense; the air is thin. Since 1951 the lake has dried out entirely, not just once but four times. In the 1951 drought the town of Nakuru was plagued by clouds of soda dust. It was even proposed that the lake bed should be sprayed with water to keep the dust down. In 1961 very heavy rains fell throughout East Africa and Lake Nakuru rose 12 feet above its previous level, submerging hundreds of acres of land and drowning whole stands of acacia. The lake level fluctuates constantly but it has never returned to its pre-1961 level. Also in 1961 a species of fish (*Tilapia grahami*) was introduced into the lake: It thrived. Until then the highly alkaline lake had been totally devoid of any fish.

During the months of December 1970 and January 1971 some 40 pelicans were found dead along the 28-kilometer shoreline of Lake Nakuru. In February 1971 (at the end of the dry season) a considerable number of fish in the lake died, their smelly bodies littering the shore. Some flamingos (of which Nakuru probably supports the highest concentration in the world) were found dead, too. There was an immediate uproar: "Pollution!" Newspapers, magazines and TV stations spread the story around the world, suggesting this was the end of Nakuru, the end of the pelican, the end of that glorious mass of flamingos.

Few thought to ask where the lake's birdlife had gone on the four occasions when the lake had dried out, or where the pelicans had been before the fish were introduced to Nakuru. Events such as these are

*Photographer-writer John Reader reported on the Tsavo elephant dilemma in* SMITHSONIAN, *July 1972.*

After a long period of inactivity, a white pelican yawns elaborately, flattening out its lower mandible.

A frieze of gregarious white pelicans stretches across the shallows at the edge of Lake Nakuru.

One of Nakuru's 400-odd bird species, a malachite kingfisher feeds on the lake's single fish species.

soon forgotten, but when a few birds and fish die some people immediately assume man is to blame.

There is no doubt that with a developing town of 60,000 spreading to within a mile of the lake shore, pollution is an ever-present threat that must be monitored. It is to be hoped that the development of Nakuru's industrial area, helped by a $2.8 million loan from West Germany, will include provision for the control and disposal of dangerous effluents. Already there are discernible quantities of detergents, biocides and heavy metals flowing into the lake. As yet, however, the quantities are small.

Tissue samples from the dead pelicans and fish were sent to Cornell University and the University of Utrecht in the Netherlands for analysis following the 1970-71 die-off. The fish were found to have 0.01 parts per million of residual DDT; the pelicans carried 0.6. By contrast, the brown pelican of the Louisiana and Carolina coasts carries 20 parts per million. Scientists were unable to establish any incontrovertible reason for the death of either the fish or the pelicans.

Popular belief is that Lake Nakuru supports one million flamingos. This figure is somewhat arbitrary—no one has yet made a convincingly accurate count. There may be as many as two million. The marvel of Nakuru's mass of birdlife has been acknowledged for years. Not until a team of German scientists began working on the lake in 1971, however, did the reasons for these vast numbers begin to be truly understood. Only during the last 12 months has it been fully appreciated that Lake Nakuru is unique; nowhere else in the world is there such a simplified, natural aquatic ecosystem. It is an ecologist's dream.

No river or stream flows out of Lake Nakuru; those flowing into it bring with them quantities of mineral salts. This, and a high rate of evaporation, has created a lake of extremely high alkalinity. Only a limited number of life forms can survive there. There is but one form of algae, *Spirulina platensis*; one species of crustacean, a microscopic copepod; one introduced species of fish, *Tilapia grahami;* and three main species of aquatic insect. These six life forms are the preliminary building blocks of an environment that supports perhaps a million flamingos, thousands of pelicans, herons, storks, ducks, darters, stilts, cormorants, kingfishers, coots and five pairs of fish eagles.

The lesser flamingo (the predominant species on Nakuru) feeds entirely off the algae. They are able to exist in such large numbers because as algae feeders they are part of an incredibly short energy cycle: algae ingested—nutrients excreted—nutrients plus sunlight by photosynthesis—more algae. The crustaceans feed on the algae; the fish feed on the algae and the crustaceans; the pelicans and numerous other birds feed on the fish; maribou storks prey on weak flamingos—a wonderful merry-go-round that excites scientists because it is so limited and relatively easily quantified. The total weight of the crustaceans (that is, their biomass) is probably greater than that of the flamingos; the pelican population alone possibly takes three tons of fish from the lake every day.

Facts—we are back to odd facts again, but they are needed. East Africa is in the very fortunate position of still having *some* time available in which to plan the future of its wildlife resources, but it is essential that these plans be laid on the basis of established scientific fact. Conservation is best described as maintenance of the energy cycle. Until all the elements within that cycle are known and their interrelationships understood, we can hardly presume to manipulate or manage it.

After all, it is possible those Lake Nakuru fish died from overcrowding. Perhaps the pelicans were elsewhere for a time and not taking their three tons of fish per day. Who can say? Daphne Nightingale's study could provide the answer and, surely, filling in just one such corner of the puzzle is enough to justify swimming around with a stuffed pelican on your head.

Throngs of pelicans and flamingos: by far the most noticeable aspect of a uniquely simple ecosystem.

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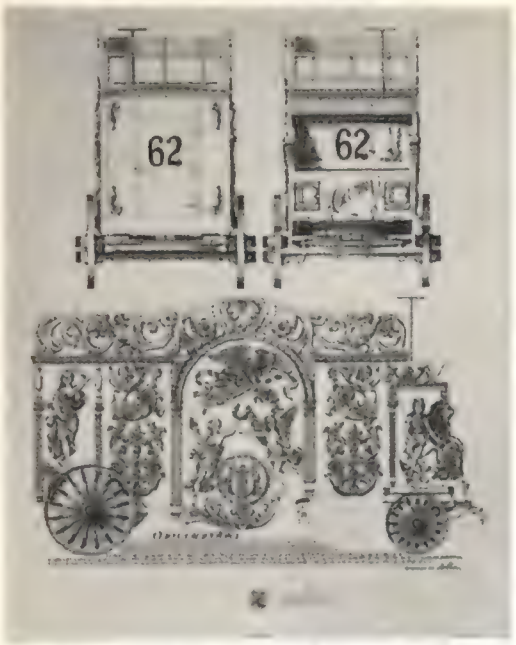


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# 'Perfect' species of brain coral

It was a considerable surprise when, in late 1969, divers found this specimen of brain coral (below, detail on opposite page) in 30 meters (98 feet) of water near Andros Island in the Bahamas. In the first place, it was in nearly perfect condition, having somehow been missed by parrotfish which often gnaw on the convoluted rows of individual coral polyp skeletons. Also, Bahamian reefs have been thoroughly picked over by divers and scientists as well as fish, so there was something of a stir in invertebrate zoology circles when Dr. John Wells of Cornell University identified the specimen as that of a hitherto unknown species.

Now deposited in the Smithsonian's National Museum of Natural History, the new species will receive its official name in 1974. Dr. Wells intends to name it after a renowned authority on corals and coral reefs, the late Thomas Goreau. His father, Fritz Goro, photographed the oyster borer (SMITHSONIAN, November 1972.)

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*The beautiful bird coins of the British Virgin Islands*

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To assure that the designs for these coins would be both authentic and artistic, the British Virgin Islands chose a sculptor who is renowned in the fields of coin design and medallic sculpture. He is Gilroy Roberts, dean of American medallic artists, who sculptured the famous portrait of John F. Kennedy for the U.S. half-dollar —and whose series of art medals—*Roberts Birds*—has won widespread acclaim for fine detail.

To capture the full beauty of the birds in their natural surroundings—to study them at flight and at rest—to capture their every mood—Mr. Roberts traveled to the British Virgin Islands. Here, on the long stretches of sandy beach, in the romantic coves and around the rock formations—he sketched the birds at close range. Later, in his studio, he turned his sketches into detailed sculptures from which the coining dies were prepared. The coins were then struck by the skilled craftsmen of The Franklin Mint, the world's foremost private mint. The result is a collection of coin of the realm that is, in every sense, a work of art.

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In honor of the 200th anniversary of constitutional government in the British Virgin Islands, a limited number of Proof Sets of its 1973 coinage, its first, will be struck for collectors. The number of Proof Sets minted will be exactly equal to the number ordered by June 30, 1973. *No other Proof Sets of this historic first year's issue will be produced.*

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To receive your sets of these unusual bird coins—"The First Official Coinage of the British Virgin Islands"—please complete the order form below and mail it directly to the official minter of the coins: The Franklin Mint, Franklin Center, Pennsylvania 19063. The final date for ordering Proof Sets is June 30, 1973. Any orders for Proof Sets postmarked after that date cannot be accepted and will, regretfully, be returned.

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31-86

# Inventor William Lear, young at 70, goes all out for clean steam

*A lively entrepreneur of aircraft instruments and plane design caught the environmental bug and built a new version of a Stanley Steamer*

He's a chunky man of medium height with metallic gray eyes and a brusque manner. He looks 20 years younger than his seven decades. Ruddy-faced, bushy-browed, he speaks in earthy language with a Midwestern accent. Not obscene, just profane. He is accustomed, say colleagues, to having his own way. He is William Powell Lear, inventor and aviation pioneer, now deeply involved in producing a steam engine for automobiles and buses.

The guiding genius of Lear Motors is a man of immense energy. His sole concession to the aging process is a short afternoon nap. Western-cut clothes give him the air of a prosperous rancher, a facade he neither encourages nor discourages. He drinks Alka-Seltzer like soda pop.

With more than 130 patented inventions, Bill Lear is a vigorous example of the self-made man who parlayed an eighth-grade education into a $26 million fortune. "As a kid, I messed around with the wireless," he says. "Back in the old crystal receiver days. I made my own by reading all the available literature. I practically lived in the library, and that's where I got my education."

Later, I would follow him on a tour of his plant—where many things besides steam-motor components are made—and be astonished by his amazing grasp of intricate wiring diagrams. "There's the right way, the

*Free-lance writer and prize-winning poet William Childress has reviewed books for* SMITHSONIAN.

Cascading flame creates near-instant steam as William Lear tests a new combustion chamber

*By William Childress*

at Leareno, the Reno, Nevada, plant
where he is developing his steam engine for cars.

*Photographs by Jon Brenneis*

Stanley twins test their first Steam Motor Carriage at Newton, Massachusetts, in September 1897.

wrong way—and the Lear way," an employee told me. "Later we find out the old man is on target."

Investment in the plant and a $450,000 monthly payroll have dipped into Lear's private fortune to the tune of $12 million. The company was recently given $1 million for research and development by the Environmental Protection Agency.

Either because he is too busy, or because he firmly controls his destiny, Lear is not one to worry. "When World War II ended," says his wife Moya, "a Lear official came to Bill and told him his investment in the war effort wasn't suitable for peacetime. In short, he told my husband he was going bankrupt—which frightened me exceedingly. I have no love for being poor. Bill just said, 'Honey, they can't bankrupt my brain,' and he's been going strong ever since."

Except for one brief spell in the mid-1960s.

"I got a call from him once," Moya says. "He'd taken a hotel room—no one knew where—and was calling to tell me he figured he might as well do himself in. He sat up there for a couple of days, then came home and said he'd changed his mind—there were things in steam that needed doing."

"I was fascinated by the old Stanleys and Whites," Lear reminisces. "Not only did I drive them, I was also a pretty fair grease monkey." This was about 1917.

Lear's first real venture was in radio. "I made and sold wireless sets in Quincy, Illinois. People in those days would sit up all night, trying to get Pittsburgh's KDKA or the Coon-Saunders orchestra from Kansas City. Then they'd spend all the next day comparing notes on what they had heard, and from where. Of course, there were some fish stories. Some people would insist they'd gotten KOA in Denver but it would be a rare event if they did."

While working as a radio repairman, he took night courses at a Tulsa high school. He was 23—and not far from his first invention, which he dreamed up while working as a radio engineer in Chicago.

"I told 'em I could make a better 'B' battery eliminator, and I did," he remembers. "All it required was a sort of converter to boost the power output."

This was to be Lear's first patent—because it was also usable in automobiles where, as in radio, batteries were often set up in tandem. The Lear device did away with the extra power supply. He lived off the proceeds for four years, then with a partner came up with the first car radio—Motorola.

"I never thought I had a snowball's chance in hell," he said. "But I was wrong. A lot of people said a radio in the car would create a driving hazard—the opposite proved true. People stay *awake* to listen to a radio. Or at least they did then."

In Des Moines, Lear saw and flew with the great early-day aviator Lincoln Beachey, who used to fly under the tops of state fair grandstands. "The guy had more guts than the phone company had wires," Lear recalls. "He flew little more than a damn box kite. After that first flight—in a Curtis JN4D—I was hooked on aviation for life." A fleeting grin crosses his face. "I got to where I would tell the flyers where they could get a little juice—most of the counties were dry then—and flew free!"

The culmination of it all was a sleek, ultra-posh ex-

San Francisco Mayor Joseph Alioto, right, accepts Lear's loan to his city of a steam bus.

ecutive jet based on a Swiss fighter-bomber design—the Learjet. Lear's name is linked with this craft more than with anything else—yet he sold all his rights in it to a Denver firm in 1967 to turn his attention to the development of a small, durable, highly dependable steam plant, or "Vapor Turbine System."

The plant is not only operable—having made a series of test runs in both bus and car—it is far advanced over most earlier engines in that it allows little vapor to escape. Frequent stops for water had to be made with the old Stanleys (about every 100 miles), which were nonetheless extremely reliable.

The Lear motor uses coils of tubing to heat water to steam, "radiators" to cool, and thus recondense the used steam back into water for use again. Such "recycling" was not easy to achieve; blowouts in the tubing often occurred—although it is impossible for the engine itself to explode. "Bill's problem," says one engineer, "is that he's a perfectionist. I think he invented the word. The engine now in use has passed all tests, *including* the Congressional clean-air requirements."

Says Moya Lear: "Bill doesn't want to be remembered for *a* steam engine—but for *the* steam engine."

Key to the Lear Vapor Turbine is a very small turbine set below the vapor generator. Running at speeds of 60,000 RPM, the tiny device drives through reduction gears to such accessories as the feed-water pump, fans and electric generator. Through a 20-to-1 reduction gearbox, it also is connected to automatic transmissions when required.

What does the engine use as a steam source?

"For a while, we used *Learium*," says one engineer. "It was a specially made-up liquid which Lear felt would be more efficient than water."

"We began calling it $L_2O$," an executive added. "It worked—but no better than water, so we went back to that [although this involves the problem of freezing]."

Invited to view a "test" of the combustor/blower heating system, I was led into a dim room where men wearing full-face plastic visors were preparing to fire something that looked like a ramjet. "What we've done is to combine the best of both jet and turbine, and apply them to a new steam concept," I was told. "Our engine will warm up in 20 seconds—and few gas engines can do that."

*Almost instant steam*

With a sudden roar, a high-pressure waterfall of flame poured from the jet, striking against a baffle down which ran sheets of water. The result was almost instant steam. It was a test of metals, not the motor itself—and in that cavernlike gloom, the reaction seemed almost alchemistic.

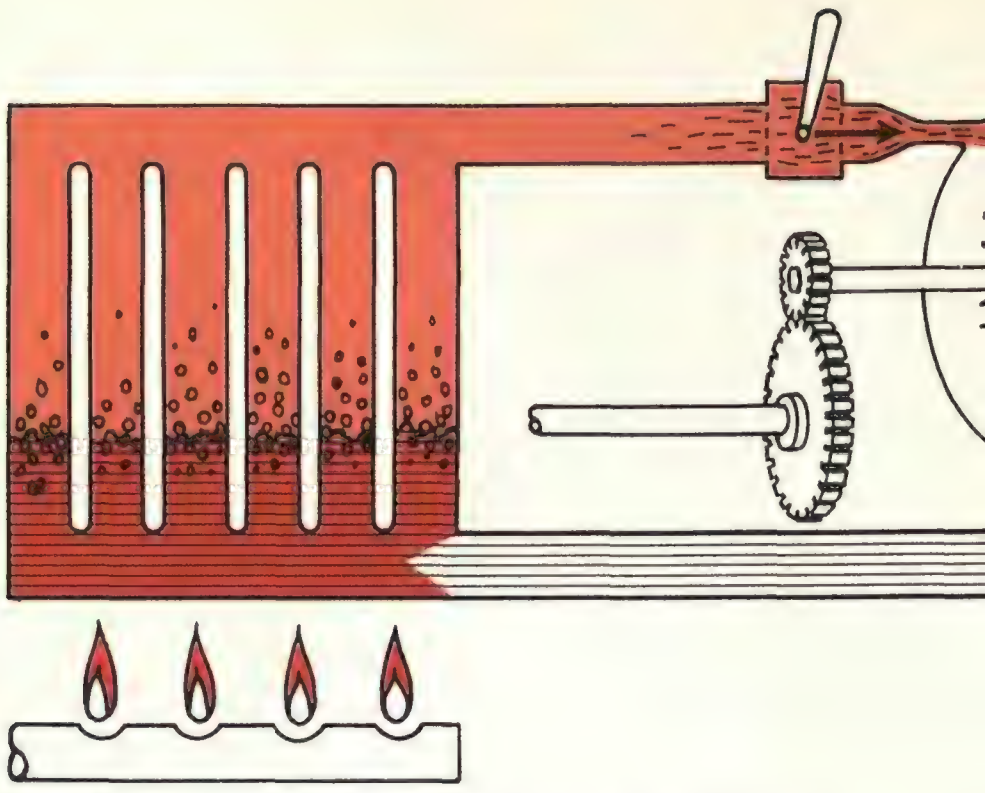
The engine develops considerable power. Recently, with a 50-percent overload of passengers, a test vehicle negotiated one of San Francisco's steepest hills—a 19½ percent grade.

Lear Motors has drawn up designs for a "minibus" capable of hauling 20 to 30 passengers. Only four feet longer than a Cadillac, it can turn in a sharper radius. "Small buses have been in use in Europe for some time," Lear says. "Only in America, with our fetish for bigness, do we build mainly monster coaches which are never filled except during rush hours. Bigness, in short, is wastefulness—and we are and always have been a wasteful nation."

Only one major car maker has shown interest in Lear: GM provided a bus and car for tests.

Asked why he chose steam, Bill replied: "The unavoidable fact is that the internal combustion engine is *inherently* dirty. Emission controls planned and now in use add up to $300 to the cost of a car, once again proving it is the customer who pays. And once installed, they require frequent adjustment and maintenance, while efficiency is reduced by seven percent (See SMITHSONIAN, March 1973).

"We settled on the Rankine steam cycle engine as the best bet to uproot the internal combustion engine. Almost any fuel can be used. And since it uses plenty of air, the fuel is nearly all combusted. It's also a closed cycle; the steam-producing liquid is recondensed and



The Lear Vapor Turbine System, drawn schematically here, has a "hot side" at the left and a "cold side" at the right. Coils of tubing facilitate heating and vaporizing water on the hot side. Steam spins

reused over and over. Power up to 250 horsepower—more than ample, because any amount above that is largely wasteful—is produced by our little turbine. You tell *me* why Detroit, instead of choosing the sensible route and opting for steam development, is trying to get Congress to reduce pollution requirements."

Lear and others are convinced the pollution handwriting is on the wall. "Public pressure is just too great," he says, "for Congress to dare going against it. The big auto companies are going to have to knuckle under. This is literally a life or death problem—and that transcends economics in my book."

"So you see a definite future for steam?"

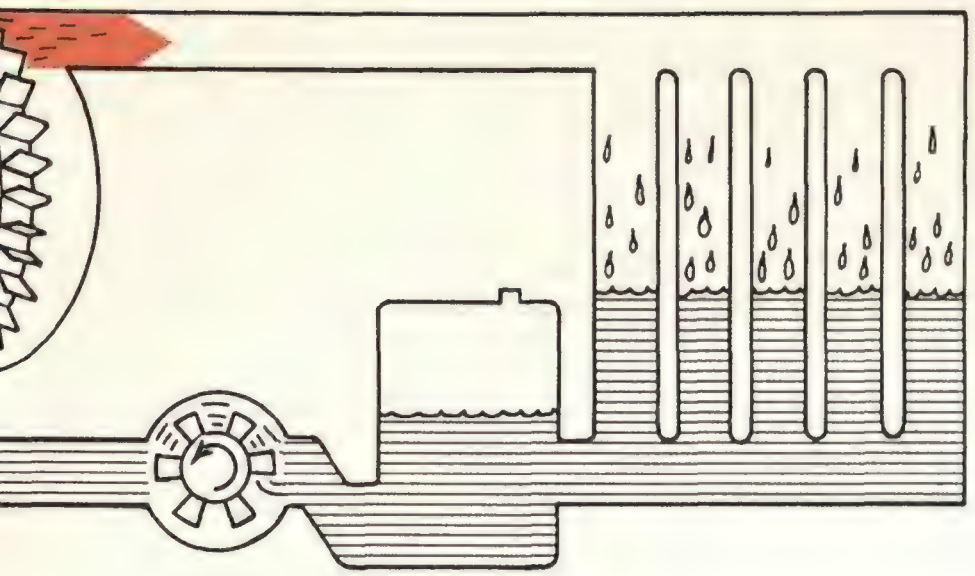
Lear snorts with laughter. "If there isn't, there won't be one for mankind, either."

In 1933, a Travel Air plane was fitted with a 90-horsepower Besler Steam Engine for a series of successful flights.

"The operation of the plane is practically noiseless," wrote one reporter, "the only sound being that of the whirring propeller. Another amazing property is that the plane can land in a very short distance, since the steam engine can be reversed once on the ground, and thus reverse the propeller." A replica of this engine will soon be on display at the Smithsonian's National Air and Space Museum.

Back in 1933 Nazi officers were passengers in a speedboat driven by the American Doble Steam Engine. The Doble was far ahead of its day, but died because of excessive fuel consumption. Gasoline engines were cheap and simple: Any kid could take apart and reassemble a Model-T Ford—which cost several thousand dollars less than the complex, limousine-beautiful Doble sedan. This luxury steam car, one of 125 makes ousted by the gasoline auto, could cruise almost indefinitely at a silent, purring 75 MPH. By 1930 Doble had sold its patents to a German firm. A 1936 newsclipping

Lear, right, and his chief engineer, Hugh Carson, adjust a steam engine fitted into a Chevrolet.



the turbine, its flow controlled by the throttle. The used steam then moves to the cold side where, again in coils, it is cooled and condensed back to water to replenish the reservoir.

Bill Lear inspects the heart of his steam system, a tiny turbine that can hit 60,000 RPM.

gives hints of what the Germans were heading for—trying to perfect steam cars and trucks "to cut out as much as possible the need for foreign oil."

A January 1928 issue of *Scientific American* informs us: "To the average person who must frequent streets crowded with traffic, the elimination of obnoxious gases which are the products of combustion in gasoline engines will be welcomed as a wholesome boon—for clean air . . . is rapidly becoming at a premium. . . ."

In 45 years we have not progressed much toward solving the problem. The three steam engines tested in minibuses last year for California's Steam Bus Project—one of them the Lear system—demonstrated that, to date, they are too bulky, expensive and thirsty to be very practical for cars.

"Fortunately," says Lear. "There are too many people interested in steam today—people with money—for the auto giants and oil companies to bury it, as they always have."

For the Detroit factories, a huge remodeling and tool-refitting would be required. One fear is that workers might lose jobs. But re-outfitting plants for steam

William Lear at his desk: He has made a long career of radio and aircraft pioneering.

cars, and the resultant junking of gasoline ones, would create more jobs than anyone ever dreamed of—or so Lear Motors believes.

"Just in education alone," says one spokesman, "jobs would be massively increased. Why, mechanics would have to be totally retrained to work on the steam engines."

Steam power has come a long way since French engineer Nicholas Cugnot rammed a wall with his "steam tricycle" (still on display in Paris), thus scaring the French army into giving up the project. In 1906, Fred Marriott drove a 30-horsepower Stanley an unbelievable 127 MPH. Its engine is in the Smithsonian. The next year, at a speed in the 190s, the car went out of control, almost killing the driver. The Stanley twins put the kibosh on any more racing. But lovers of the old Steamer say that no one ever had the courage to keep the throttle open.

A keen wind kicks up gouts of dust near Lear's hangar at Leareno (as he calls his cluster of buildings) on the bleakly beautiful Nevada desert. A freak snowstorm makes the loaf-shaped blue hills look as though someone had passed a flour sifter over them. Lear, bound for a Los Angeles speaking engagement, walks with his wife toward the gleaming, needle-nosed jet that made him famous.

Somehow, the sight of this former farmboy ordering trained men around a huge plant was a reminder of Edison. Neither man had any real formal education. Both evinced a creativeness that obviously sprang from a much deeper, inner well.

Lear can be cantankerous and admits it. "But I pay for it," he had said moodily, back in his office after a plant tour. His detractors say he's gone dotty, that to try and add to the future of technology by searching through the moldy past is evidence his age is catching up. I don't believe it. I have seen a secretary come in and lay a sheaf of papers in front of him while he was talking. Without missing a syllable, Lear read and signed each paper—a remarkable demonstration of how a man can literally split his mind. Lear is very big on what he terms "dream thinking." He feels his subconscious digests the problems he goes to bed with, then comes up with an answer in the morning. For him, at least, it works.

The cold Nevada wind whips sharply as evening purples. The gleaming Learjet—still as sleekly beautiful as when it was designed 11 years ago—waits in front of the double-doored hangar. William Lear and his wife climb in. A door comes down out of the craft's roof. The plane taxis towards the end of the runway, where it sits poised like a knife in the deepening dusk.

Then a stab of flame comes from its tail, and it whistles forward like a javelin. Its thunder grows louder, louder, rattling the clustered tin buildings. Then its wheels are up and it is gone over the thin desert vegetation.

William Lear, 70, is rocketing into tomorrow on dreams of yesterday.

At a company picnic, the boss happily sprays beer amid the smoke—but not steam—of a barbecue.

*By Gary Soucie*

# Where beaches have been going: into the ocean

*When man, like King Canute, attempts to referee the game between waves and sand, the waves usually win and beaches vanish*

For a continental nation we are curiously oriented toward our beaches and shores. During the last decade 90 percent of our population growth has occurred within the 30 states that border our seacoasts and Great Lakes. The 30 coastal states contain 75 percent of our total population and 12 of our 13 largest cities. In fact, nearly half the population lives within our coastal *counties*. So what happens to our beaches and shores is of more than passing importance to us, and what's happening to them isn't good.

In recent years, as environmental awareness finally has caught hold across the land, little attention has been paid to the rapidly increasing problem of beach erosion. It would be a terrible irony, wouldn't it, if we were to get our coastlines cleaned up just in time to watch the beaches disappear beneath the clean waters?

People who live in the immediate vicinity of our coastal margins are aware of the erosion problem, and they have been complaining increasingly as the coastlines have become more heavily developed. In 1968 Congress directed the U.S. Army Corps of Engineers to conduct the National Shoreline Study. When the Corps delivered its report in 1971 we learned that 20,500 miles of national and territorial shores are ex-

These mesalike forms are all that is left of a road near California's El Granada beach, constructed by men who forgot that it is the nature of a beach to move.

## *Beach erosion*

periencing significant erosion. That's one-fourth of all our shoreline, and excluding Alaska's 15,400 miles brings the eroding portion up to 43 percent.

Because of the phenomenal explosion in beach recreation, most interest has been focused on the erosion along that one-third of our shoreline that has beaches.

It doesn't take a lifelong study of beaches to recognize that they are areas of instant geology, their sands shifting constantly under the battering of the waves. The beach, as American naturalist William Beebe wrote, is "the battleground of the shore." The constant shifting of the sand before the waves is not in itself erosion, for the waves that tear sand away from the beaches are what built the beaches in the first place and have maintained them ever since.

During calm weather, wave action tends to push sand and sediment from the sea bottom onto the beach; during storms, extreme wave action tends to take back what was deposited earlier. For this reason the typical beach has two faces: a summer profile that is wide and flat, and a winter profile that is narrow and steep. Continental erosion is the original source of beach sediment. Glacial deposits, the sediment-laden runoff from rivers and streams and the erosion of sea cliffs and headlands by waves are what provide the materials for beach building. As the sea level fluctuated over the ages, wave action kept these sediments near the shore, whether the seas were high or low.

Generally speaking, a beach that remains undisturbed by Man is in a state of equilibrium, with the sediment carried away by storm waves roughly equal in magnitude to the sediment that is carried landward during calmer weather. So, all other things being equal, beaches are forever, but in different places at different times.

All other things are not, however, always equal. Over a long period of time a given beach may experience a net loss of sediment. Hurricanes and great storms may wash sand over a barrier beach into coastal lagoons to form shoals. Over a longer period of time, of course, these shoals will eventually become part of the barrier's backside, bringing the beach system back into equilibrium. Or, as happens in many areas, strong winds may blow sand from the beaches into inland dune areas. Again, within geologic time, coastal erosion may eventually move the shoreline landward until the dunes again become part of the beach. Very strong storm-wave action may set up powerful return currents that wash sediment away from the beaches and out onto distant shoals or the continental shelf, to all intents and purposes a permanent loss of beach sediment. Some coasts, like California's, have submarine canyons close to the shore which trap beach sand.

Because waves usually strike the coastline at an angle, longshore currents are formed, and the beach sand caught up in this littoral drift is moved away from its "original" location. Geological analysis of Miami Beach sand has shown that it came, ages ago, from the Piedmont region of the Carolinas.

Over the long geologic haul, then, beach erosion is a natural process of building as well as taking away beaches. On an undeveloped shore, there is really no such thing as beach erosion, only the movement of sediment as the sea resculpts the shoreline.

### *The best defense is to disappear*

The real conflict of the beach is not between sea and shore, for theirs is only a lovers' quarrel, but between man and nature. On the beach, nature has achieved a dynamic equilibrium that is alien to man and his static sense of equilibrium. Once a line has been established, whether it be a shoreline or a property line, man unreasonably expects it to stay put. But beaches are fragile: Their seeming instability is their best and only defense.

A 1964 Corps of Engineers document, "Land Against the Sea," states: "Unfortunately this natural mode of defense does not retain the former boundaries of the dry landmass in a stable position relative to the sea, nor does it occur when needed, but rather at irregular and unpredictable intervals. Therefore it has been necessary for man to enter the battle with his structural defenses for stabilization." In that self-righteous and anthropocentric statement are all the ingredients for turning benign shore processes into beach erosion.

To catalog the coastal structural defenses we have built is to sound a litany of unnatural disaster and rout:

*Once a newsman on North Carolina's eroding Outer Banks, Gary Soucie has described the plight of the Great Dismal Swamp in* SMITHSONIAN, *July 1972.*

The results of building jetties at Santa Cruz: Littoral currents soon build up sand on one side and carry it away from the other side, thus threatening the beach of this overdeveloped shore.

*Harbor jetties:* Built to protect our harbor entrances, jetties have caused untold erosion of beaches downdrift of them. In *Our Changing Coastlines,* Francis P. Shepard of the Scripps Institution of Oceanography and the late Harold R. Wanless of the University of Illinois wrote: "South Cape May has virtually disappeared during the past 50 years due to the jetties to the northeast and to the southerly current. Assateague Island has been eroded at least 1,500 feet because of the Ocean City jetties. Loss of most of a small peninsula, formerly a seaside resort, at Tillamook, Oregon, can be laid to the long jetty built on the north side of the harbor entrance."

*Bulkheads, seawalls and revetments:* These vertical structures, built on eroding coasts to protect threatened developments, reflect almost completely the wave energy which then scours away the beaches in front of them, exposing the structures to the direct attack of the waves. In 1969 Nelson Trimble Levings spent $38,000 on a bulkhead to protect the 16-room, Norman-style house that has been maintained at Southampton Beach since 1928. Less than a year later the sea had destroyed his bulkhead, so Mr. Levings had to spend another $106,000 to move his house 180 feet back from the beach. "You can't beat the ocean," he said later. "I learned from that bulkhead experience that you better not fight the ocean too hard."

*Groins:* Long the favorite devices of engineers and beach property owners to fight beach erosion by trapping sand drifting in the littoral current, groins only rob Peter to pay Paul. Lim Vallianos, chief of the Coastal Engineering Studies Section of the Corps' Wilmington, North Carolina, District, admits: "Though the groin can be an extremely effective structure, its indiscriminate use can be catastrophic to adjacent shores which are deprived of the sand which is entrapped within the groin compartments."

*Breakwaters:* These offshore parallel structures cause "wave shadows" that interrupt littoral drift and cause the beach immediately behind and updrift to trap sand. In 1929 a breakwater was built at Santa Barbara to protect the harbor entrance. Wesley Marx described its effect in *The Frail Ocean:* "Below the breakwater the shore receded as much as 245 feet. Ten miles downstream a row of beach houses slumped into the sea. The breakwater that cost less than a million dollars to

Erosion has nibbled bluff on California beach and will quicken as waves meet the steeper slopes.

On North Carolina's Outer Banks, buildings toppled as the beach front fell victim to a winter storm.

build caused twice that amount in property damage."

*Artificial dunes:* During the Depression, the Civilian Conservation Corps built a line of high dunes along the Outer Banks of North Carolina to stabilize the barrier islands. When Cape Hatteras National Seashore was established in 1953, the National Park Service built the dunes even higher. Research done for the Park Service by University of Virginia coastal geologist Robert Dolan and University of Massachusetts plant and coastal ecologist Paul Godfrey has shown that the dunes are causing erosion by preventing the overwash of sand which would naturally build up the backside of the islands to replace what was lost to storms on the seaward side, and that the actual erosion of the beach has been intensified because the dunes have steepened the angle of wave attack. Since 1586, when Sir Francis Drake reported a hurricane, the Outer Banks have survived at least 149 of them, but in February of this year a *moderate* storm eroded miles of beach and destroyed whole sections of the dunes. National seashore superintendent Robert Barbee lamented: "We started out with 500 feet of beach we thought was stable. Now it's gone."

Other nondefense structures have caused erosion. Artificial inlets dredged through the East and Gulf Coast barrier beaches are effective sinks that starve the beaches of sand. Many attribute the fierce erosion at Miami Beach to the 17 dredged inlets along Florida's east coast. According to the Southern Florida Hotel and Motel Association, of the 500,000 cubic yards of sand flowing annually past Jacksonville, only 10,000 cubic yards survive by the time they reach Miami Beach. As former mayor Jay Dermer remarked, "Our last name is Beach and we don't have a beach."

### *Tsunamis and a rising sea*

On the West Coast, where rivers and streams flow directly into the sea and should be the major source of beach sediment, flood-control and water-supply dams are estimated to trap 50 percent of the sediment that once flowed out onto the beaches. The rapid urbanization and paving of the California coast is also contributing to beach erosion by reducing the production of natural debris that would have eroded into the sea. University of Southern California geologist Bernard W. Pipkin has said that "what few studies have been conducted suggest that sediment delivered to the beaches will be reduced another 30 percent by the year 2000, even if no more dams are constructed."

Some geologists believe that hurricanes and tsunamis (seismic sea waves generated by earthquakes), which are the most erosive of the natural forces, have become more frequent over the past few decades. There is some evidence that the long slow rise in the sea level has accelerated within the past decade. Last fall the National Geodetic Survey released data that showed a subsidence of the Earth's crust along most of the Atlantic and Gulf Coasts of 1 to 15 millimeters per year. In recent correspondence Samuel P. Hand, chief of the Survey's Vertical Network Division, said, "I can only express an opinion that it is probably effected by crustal movements." Southern California's weather runs in wet-and-dry cycles of about 25 years, corresponding roughly to the double sunspot cycle that affects Earth's weather. In a dry cycle, little sediment gets washed into the sea.

### *Like building on a volcano*

Drought, hurricanes and tsunamis can pose serious problems periodically. Sea-level rise and crustal subsidence may point to a slow encroachment of the sea over the very long run. But man is the primary beach-erosion problem. In 1957 Hurricane Audrey hit the barrier islands of the Gulf Coast a smashing blow. Waves and tides up to 12 feet above normal driven by winds of more than 100 miles an hour eroded shores 200 to 400 feet and washed beach sand over into the tidal marshlands. Nine months later James P. Morgan conducted a field study of the area and reported: "The effects of the damage are almost gone, indicating that all of this low coastal area is more or less in equilibrium with hurricane conditions. The only permanent damage was to the poor peoplewho tried to live there."

Now that man has created the problem, what can he do about it? The structural engineering approach has been an utter failure.

First, undeveloped beaches and shorelines must not be developed so close to the surf zone that frequent storm damages and periodic losses of shore-front property prompt the kinds of remedial action used in the past. The Corps' Lim Vallianos has observed that "erecting a building on a beach is like building on an active volcano. You take your chances and, sooner or later, you lose."

Of our already developed beaches, it is clearly impossible to hold the line against the sea forever; on the other hand the value of beach development, both private and public, and the threat to human life demand that we do something. Because we have made so many mistakes in shoreline development, we will have to take an occasional hard knock from hurricanes and northeasters, no matter what we decide to do. When that happens we must insist—through zoning and through conditions attached to low-interest federal disaster-assistance loans—that rebuilding of damaged structures be done farther back from the shoreline. Defending coastal developments is going to take fantastic expenditures of private and public capital.

In the long run it will probably be cheaper to buy back into the public domain a great many of our privately owned and precariously developed beaches than to subsidize their protection. While waiting for that day of reckoning, we must develop wiser and more sensitive approaches to beach-erosion control and shore protection so that, once we withdraw to new positions along the coast, natural processes will be able to reestablish themselves with a minimum loss of resource. That means we are going to have to abandon the outmoded and disastrous practices of the past; beachfront property owners are going to have to give up their pet theories and one-shot solutions and the engineers their sacred cows. Real estate development consultant William R. Vines has stated that "in no other resources management field is there more misconception, mysticism and generally confused thinking than in beach-erosion control." The Army Corps of Engineers has lately shown signs of enlightenment, restraint and humility. Rudolph Savage, chief of the research division of the Corps' Coastal Engineering Research Center, admits that "no one really knows what's going on. No one has the answers. We don't. That's why we're doing research." This kind of thinking has begun to filter out into the Corps' construction branches, the Engineer Districts. Gilbert K. Nersesian, chief of the Beach erosion and Hurricane Section, New York District, told me: "Coastal engineering is an art, rather than a science, at the present time." In fiscal year 1973 the Corps spent nearly $4 million on coastal engineering research and development (more than four-and-a-half times as much as was spent on research in 1965) and virtually nothing on beach-erosion control construction projects.

There is a growing consensus among geologists and engineers alike that, unless intensified research turns up something better, about the only sensible recourse for overdeveloped and eroding beaches is to keep pumping and dumping sand to feed the littoral drift. The sand for beach nourishment would come from the dredging of harbors, inlet shoals and offshore sources like bars, shoals, or the ocean bottom itself. (For ecological reasons, however, bay bottoms have become largely off limits for dredging beach fill.)

Beach nourishment is an expensive proposition. Costs vary at present from $2 to $5 per cubic yard of sand and the Corps estimates that along the beaches of New York and New Jersey alone there is a sand deficit of about 200 million cubic yards. And beach nourishment is not a one-shot process; after an initial fill, periodic fills, perhaps annually, will be necessary to keep enough sand moving in the littoral drift. In a report by the Corps of Engineers it is estimated that owners of 50-foot beachfront lots along the Outer Banks would have to spend about $20,000 for the initial beach restoration and between $1,000 and $2,000 a year thereafter for maintenance fills. Robert Dolan then concludes that "Investments of this magnitude obviously limit beach-erosion control projects to coastal areas where man's confrontation with the sea has implications of national significance." The National Shoreline Study points out the need for immediate attention to 2,700 miles of critically eroding shoreline at an intial cost of $1.8 billion and $73 million a year to maintain average beach nourishment. One can hardly imagine the costs if we tried to halt or slow down erosion on the other 17,800 miles of significantly eroding shoreline.

Wesley Marx wrote: "Outflanked by hurricanes, breakwaters, dams and artificial islands, the Corps will have to reinforce an impotent littoral drift with larger and lengthier sand convoys. In time the Corps may even become the littoral drift." It is no wonder that some longtime skeptics of the Corps of Engineers see the National Shoreline Study as a self-serving blueprint for bureaucratic expansionism. I was once one of those skeptics, but now I'm not sure. What are the alternatives? Surely not the groins and breakwaters and other "structural defenses for stabilization" that helped to cause the problem in the first place.

We have got ourselves into a mess along the beaches and we won't get out of it easily or soon. It is just too bad that most of the people who caused most of the beach erosion problems in the first place, and who had full use and enjoyment of the beaches for a time, won't be around to help pay the bill.

A West Coast river deposits tons of silt with which littoral drift will replenish a beach elsewhere. As such rivers are dammed, the beaches are starved.

*By Thomas Fleming*

# Monticello's long career—from riches to rags to riches

*Sunk into genteel decay, Jefferson's mansion was reborn. Labor pains started 50 years ago with a Russian immigrant as midwife*

Early in 1971, two senior citizens of Whittier, California, received an unusual invitation. "Thomas Jefferson presents his compliments to Mr. and Mrs. Theodore Fred Kuper and requests the favor of their company to dinner on Monday, April 12th, at 7:30 P.M. [at] Monticello. The favor of an answer is requested." In a matter of minutes, Theodore Fred Kuper had written and addressed his acceptance to "Mr. Thomas Jefferson, Monticello, Charlottesville, Virginia."

Faithful to their reply, Mr. and Mrs. Kuper arrived at Monticello and joined a highly select group of guests at a candlelit dinner in Jefferson's dining room. Solemnly they toasted the President of the United States, the spirit of Thomas Jefferson and the University of Virginia. Kuper was presented with a resolution passed by the board of directors of the Thomas Jefferson Memorial Foundation, thanking him for his "selfless dedication" and "devoted services."

Fifty years ago this year the Foundation was incorporated and took title to Monticello, rescuing it from a century of neglect. And the American whose zeal was largely responsible for this historic rescue was a pint-size Jewish immigrant—he stands barely over five feet—born in Moscow and brought to the United States at five: Theodore Fred Kuper.

Jefferson died in 1826, so impoverished that he had beseeched the Virginia House of Delegates for permission to raffle off his beloved mansion. Monticello's furnishings were first sold at auction, then the house went for a song. In 1836 it was bought by Uriah Phillips Levy, a naval officer who rose to the rank of commodore. When Levy died in 1862, his heirs discovered that he had left Monticello to the American people as an agricultural school for the orphaned children of Navy warrant officers. Congress, harassed by Civil War problems, turned down the gift, and Levy's family quarreled over his will for 20 years.

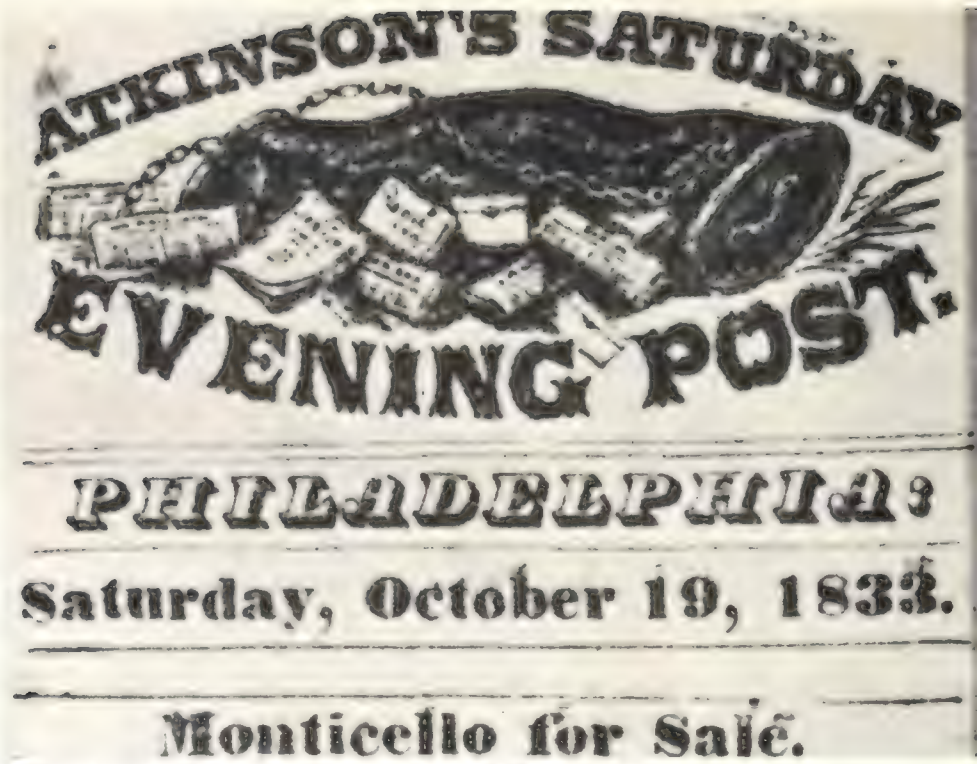
Monticello, meanwhile, declined toward total collapse. A Congressman who visited it in 1878 reported: "Desolation and ruin mark everything around the place. . . . There is scarcely a whole shingle upon it. . . . The windows are broken, everything is left to the mercy of the pitiless storm." The Congressman called it a "standing monument to the ingratitude of the great republic." Levy's overseer stabled cattle in the mansion's basement, set up a hand fanning mill on the parquet floors of the drawing room and winnowed his grain there.

Finally, one branch of the Levy family used cash to soothe the other litigants and slowly acquired control. In 1881, Jefferson Monroe Levy became sole owner and began restoring the mansion. But he was no historian and the result of his efforts was a 19th-

Theodore Fred Kuper, center, was photographed at age three, before his family left Moscow . . .

*Mr. Fleming is noted for books on the Revolution and a Jefferson biography,* The Man from Monticello.

. . . Eighty-four years later, Kuper stands outside the American shrine he helped to rescue.


ATKINSON'S SATURDAY
EVENING POST.
PHILADELPHIA:
Saturday, October 19, 1833.
Monticello for Sale.

This ad for Monticello appeared three years before Uriah Levy bought the estate.

century version of a comfortable country home. Wealthy from Wall Street speculation, Levy made the house an extension of his rather large ego, a place to entertain important political and business friends. He resisted vehemently several moves, mainly by Mrs. Martin W. Littleton, to persuade the government to buy the mansion and convert it into a shrine. When one Jefferson admirer, William Jennings Bryan, became Secretary of State in 1913, he could extract nothing from Levy but a prohibitive purchase price: a half-million dollars.

Shortly after World War I, Levy ran into turbulent waters on Wall Street and decided to sell Monticello. He asked $400,000. This news led to the creation of the Thomas Jefferson Memorial Association, a Richmond-based group. They proposed to raise the needed money by an appeal to the public. They failed, and a Washington, D.C., organization, the National Monticello Association, headed by Marietta Minnegerode Andrews and Rose Gouverneur Hoes, came to the fore. They hoped to repeat the success of the ladies who rescued Mount Vernon. They, too, got nowhere.

Early in 1923, the Thomas Jefferson Memorial Foundation appeared, with a Virginia-born lawyer, Stuart Gibboney, as president. With the help of Judge Moses H. Grossman, Gibboney recruited a number of distinguished names for the board of directors.

Two weeks after the Foundation opened, Fred Kuper went to work for them, largely, he frankly admits, "because I needed a job." After moderate success as a New York lawyer, he had a disastrous venture in the oil industry. Gibboney hired him at $50 a week and he was first given the job of creating a letterhead. Kuper got out several books on Thomas Jefferson and came back with a motto that is still used by the Foundation: "All my wishes end where I hope my days will end—at Monticello. Thomas Jefferson."

Commodore Uriah Phillips Levy owned the mansion for 26 years, then tried to leave it to the nation.

Meanwhile the Foundation was having troubles. Jefferson Levy privately upped his price to half a million and attempted to bully the Foundation into paying the full amount in cash. After some haggling, Gibboney and Grossman paid him $10,000 with personal checks, and Levy signed the option agreement, which would give the Foundation title to Monticello if they could raise $90,000 by December 1, 1923.

With a rush of euphoria, the Foundation announced plans to raise $250,000 by the deadline, and set up a nationwide organization. Kuper, meanwhile, was sent to Washington and Richmond to persuade the good ladies of the Thomas Jefferson Memorial Association to join the Foundation. He had some tense moments in the midst of this task, because Stuart Gibboney had got his name in the paper for allegedly slapping a lady friend in the face while he was obviously under the influence of illegally acquired bourbon. She called the police. Gibboney, mortified, considered resigning as Foundation president, but Kuper persuaded the Washington ladies to forgive and forget. One grande dame chuckled and said, "I tell my sons the only liquor that you can drink is the stuff I have on my buffet. I know that's all right. Tell Stuart not to touch any of the other stuff anymore."

Jefferson Monroe Levy, the Commodore's nephew, was Monticello's last private owner—for 42 years.

In New York the Foundation tried to elicit large donations from the wealthy, and simultaneously projected a "spiritual pilgrimage" to Monticello with a dinner to be held on a train in Grand Central Station. Notables such as Senator Royal S. Copeland sold "tickets" at one cent a mile. This idea was a financial disappointment.

Large donors also failed to come forward in encouraging numbers, and an underwriters' program flopped. In desperation, the Foundation announced in July an even more grandiose goal—the raising of $1 million to buy Monticello and endow it. To produce this mountain of cash the Foundation arranged a speaking tour by distinguished members, but the attempt to get these notables failed.

Kuper realized that the Foundation needed an educational program. As Merrill D. Peterson points out in his excellent book, *The Jefferson Image in the American Mind,* the early 1920s were one of the several nadirs of Jefferson's public reputation. Hamilton was the name invoked by President Harding and his fellow Republicans. Jefferson's thinking was equated with Wilsonian idealism, which had been repudiated.

In Detroit, Kuper found that one of the most distinguished members of the local Foundation committee was on the point of resigning. Jefferson, he said, was an atheist. Kuper asked the man if he had ever seen the "Jefferson Bible." He then described how Jefferson had culled the best teachings from the Gospels and had them printed in four columns, one in Latin, one in Greek, one in French and one in English.

### *Winning over the KKK*

There was another problem. The Ku Klux Klan was at a high tide of influence in the Midwest and the South. In Texas, a man frankly admitted to Kuper that he was the Kleagle of his klavern, but took such a liking to the ebullient little Jew that he invited him to become an honorary member. "This convinced me," Kuper says, "that most people were not so much prejudiced as they were suffering from blind spots."

He began to build a simple speech telling how Jefferson, on his deathbed, had instructed his family to omit on his tombstone any mention of his being President, Vice President, Secretary of State, Ambassador to France, Governor of Virginia. Instead, he wanted only the words: "Author of the Declaration of Ameri-

The house, photographed in 1870 while litigation raged around it, shows signs of disrepair.

can Independence, of the Statute of Virginia for Religious Freedom and Father of the University of Virginia." Thus Jefferson defined the basic ideals of America—civil liberty, religious freedom and educational opportunity.

In Phoenix Kuper made seven speeches, beginning early in the morning and ending towards evening in the state's senate chamber with the governor presiding. At midday, when he was walking to the car, one of his escorts fell in step beside him and whispered, "My God, the angels must have sent you. I'm a Catholic, and we haven't been able to make Christians out of these sons of bitches, but you are doing it in seven speeches. God bless you."

Kuper returned from his trip with the realization that "Thomas Jefferson did not open the purse strings of people with real money," and that "even among people of modest means, he was a forgotten man." Everywhere there was a dearth of Jefferson literature. "When I went to old book shops and inquired for a volume of the life of Jefferson, I was sometimes handed the life of Joseph Jefferson, the actor. . . . In Washington, D.C., I was given a book on Jefferson Davis."

When the grim day of payment arrived on December 1, 1923, Gibboney and Kuper had to call in 80 percent of the signed promissory notes of those who had declared their willingness to pay the difference between the money raised and the needed $100,000.

To search the title of Monticello, Kuper retained Thomas Jefferson Randolph IV, member of the Virginia Bar and a descendant of Thomas Jefferson. As Kuper recalls it, "The abstract of the title was a superbly drawn document which he presented to the Foundation without any charge. The gift was all the more appreciated since Mr. Randolph was far from being one of the wealthier Jefferson descendants."

Kuper had 300 mortgage bonds printed "in handsome Wall Street fashion." In an emotional scene, the cash and the bonds and the second mortgage were delivered to Levy and he signed the deed conveying to the Foundation full title to the property. As he signed, Levy burst into tears. In his own way, he had loved Monticello, too.

The Foundation was now in charge, but still had a $400,000 debt to pay off. They also had to begin running Monticello itself. Kuper and Gibboney went down to Virginia and drove to the top of Jefferson's "little mountain." There they met Thomas L. Rhodes, Levy's caretaker, a worshiper of Thomas Jefferson. He had read and reread an early biography of him until it was a dog-eared wreck. Rhodes was also a passionate supporter of the Lost Cause. Above his cottage only a few steps from Monticello fluttered the Confederate flag.

Kuper and Rhodes mapped out ground rules for the future operation of Monticello. Each visitor was to be charged 50 cents and given a receipt with Jefferson's signature on it. For guides, the Foundation would use local blacks who sometimes helped Rhodes at the estate. Kuper concocted a brief lecture for them to give. As for the Confederate banner, Kuper politely asked Rhodes to replace it with an American flag. He could display the Stars and Bars inside his own house but Monticello was now an American shrine.

Rhodes nodded. He had imbibed enough Jeffersonian ideas to swallow this directive with a minimum of pain. "But what are you going to do with the Niggers?" he asked.

Taken aback, Kuper finally realized that Rhodes

Senator Copeland of New York sells tickets for a "spiritual pilgrimage" on a stationary train.

was talking about rest-room facilities for Negro visitors. Calmly, he explained that the man who wrote "all men are created equal" could not possibly approve of segregation. "From that year," Kuper says, "Monticello was an island of integration in the segregated South."

Kuper returned to New York with Gibboney and tackled the staggering problem of how to raise $400,000. He saw no hope of success, unless the campaign somehow combined education and pleas for cash. This insight led directly to one of Kuper's best brainchildren, Jefferson's birthday parties in the schools. The day was proclaimed by state governors in many parts of the nation, and at 11 o'clock on April 13, the school bells rang and children were asked to recite a "Patriot's Pledge of Faith" written by Kuper. Then, as a token of their sincerity, each child gave at least one penny to help save Monticello. A penny deluge resulted.

Another Kuper brainchild was born when he began explaining to a wealthy friend the Foundation's educational goals and offhandedly remarked that "it would be wonderful if we could have a group of New York City elementary schoolchildren taken to Monticello." The wealthy friend not only offered to pay all expenses, but asked to come along, too. One boy and one girl were selected from each school district.

"We reserved two Pullman cars," Kuper recalls. "Many of these children came from the poorest families. Some had never crossed the Hudson River; some had never been on a train before."

The children had the responsibility of reporting their experience to their classmates, and they industriously took notes on what they saw in Charlottesville, both at the University of Virginia and at Monticello. Later the wealthy friend told Kuper that he "felt like a thief" because the whole expedition cost only $1,500, and he had never enjoyed himself so much in his life.

By 1925, the Foundation thought they were within sight of the Promised Land. The following year was the 100th anniversary of Jefferson's death and the 150th anniversary of the ratification of the Declaration of Independence. Surely the nation—perhaps even the Congress—would respond more generously to a Jeffersonian appeal. A committee to celebrate the bicentennial of George Washington's birth in 1932 had already received a hefty appropriation from the government.

A centennial committee was formed, but the Foundation found themselves involved in a political crossfire. New York Governor Al Smith was invited to Monticello to speak at the Fourth of July exercises. Smith already was a hated man in the South because in the 1924 Democratic convention he had deprived the Southern favorite, William McAdoo, of the nomination. In a public letter, "A Daughter of the American Revolution" accused the Foundation of being in league with the Jesuits and the Pope. Smith quickly withdrew as a guest of honor. The DAR repudiated their bigoted "daughter," but the damage was done.

### *Not even $25,000 from Congress*

Nevertheless, Kuper drafted a bill to create a U.S. commission to observe the sesquicentennial of American independence and the centennial of Jefferson's death. Keenly aware that he was dealing with a Republican administration, Kuper asked a very modest appropriation—$25,000. Several weeks later, Senator Royal S. Copeland, who had introduced the bill in the Senate, called Kuper and said, "I've just left the committee room for a few moments. I have been told very frankly and positively that this bill will not pass if it has one dollar of appropriation. What will I do? We're at the end of the rope."

Sadly, Kuper told him to strike out the appropriation, and the bill passed.

As part of the Sesquicentennial Exposition in Philadelphia, Kuper rehabilitated a gig, found at Monticello, which may have been the one that Jefferson drove to Philadelphia in 1776. Kuper got the American Automobile Association to help organize a procession of more than 1,000 cars to follow the gig as it repeated its journey from Charlottesville to Philadelphia. President Coolidge was persuaded to meet the caravan in Washington and make a small donation.

Meanwhile, the Foundation got some help from unexpected sources. In 1925, Claude G. Bowers published

Thomas Jefferson's bedroom in 1924, before the Foundation got around to restoring it . . .

. . . and now, again as Jefferson knew it—but used here as a coatroom for guests at the dinner.

his best seller, *Jefferson & Hamilton,* which did much to rehabilitate Jefferson's reputation among the reading public. Even more important in some ways was the acquisition of the architectural scholar, Fiske Kimball, to head Monticello's restoration committee. Kimball published numerous articles and made many helpful statements about the cultural importance of restoring Monticello to its original splendor. He also made sure that the restoration was not delegated to well-meaning amateurs, such as Jefferson Levy. He scoured Jefferson's papers, finding sketches which showed the style of Monticello's window curtains, numerous pieces of furniture and features of the grounds. He also urged many Jefferson descendants to contribute original Monticello furniture.

By the end of the anniversary year, 1926, the Thomas Jefferson Foundation had passed the halfway mark in their struggle to achieve a debt-free Monticello. Kuper remained as director of the Foundation until 1935, the last three years without pay because of the Depression. He never succeeded in luring a Republican President to Monticello. Calvin Coolidge, nominal head of the Sesquicentennial Commission, visited the University of Virginia for a football game, yet did not go ten minutes out of his way to visit the mansion. On the other hand, while Franklin Roosevelt was New York governor, Kuper escorted him through Monticello. "He rested on my elbow as we went through the rooms," Kuper recalls. "I pointed to Monticello's empty bookcases and explained that Jefferson had sold his 'great' library to Congress and another smaller library had been dispersed when the mansion was auctioned after Jefferson's death. I also told him that in the confusion many of Jefferson's papers disappeared." The future President shook his head in disbelief.

Thanks to President Roosevelt, a Jefferson renaissance began in the 1930s and gained momentum. There was a spate of new biographies, Congress authorized funds for the Jefferson Memorial in Washington, and the definitive edition of Jefferson's papers under the curatorship of Julian Boyd was launched at Princeton University.

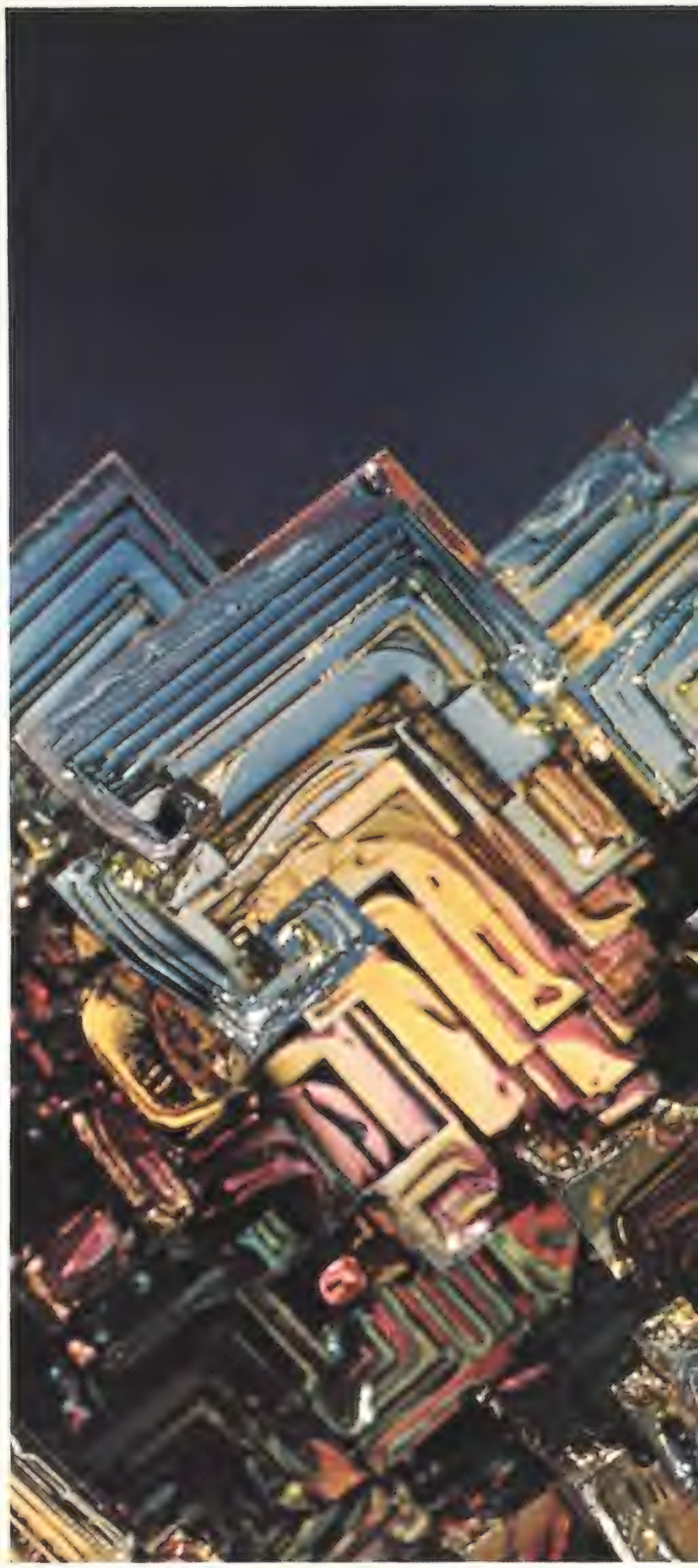
Fred Kuper is the last survivor of the men and women who struggled to rescue Monticello. This April, again, he and his wife made their way to Mr. Jefferson's candlelit dinner party to celebrate the 50th year of the Foundation. Thanks, in part, to the enthusiasm and courage of the little man from Moscow, millions of Americans of every age have sensed the "winged soul" which Jefferson gave to democracy.

In Jeffersonian candlelight, diners including Fred Kuper, nearest at left, mark the Foundation's 50th year.

*Text and photographs by Joel E. Arem*

# The dazzling crystals that man can make

*Do you want a sapphire ring, a ruby rod for a laser or a gigantic salt crystal for optical equipment? It can be synthesized*



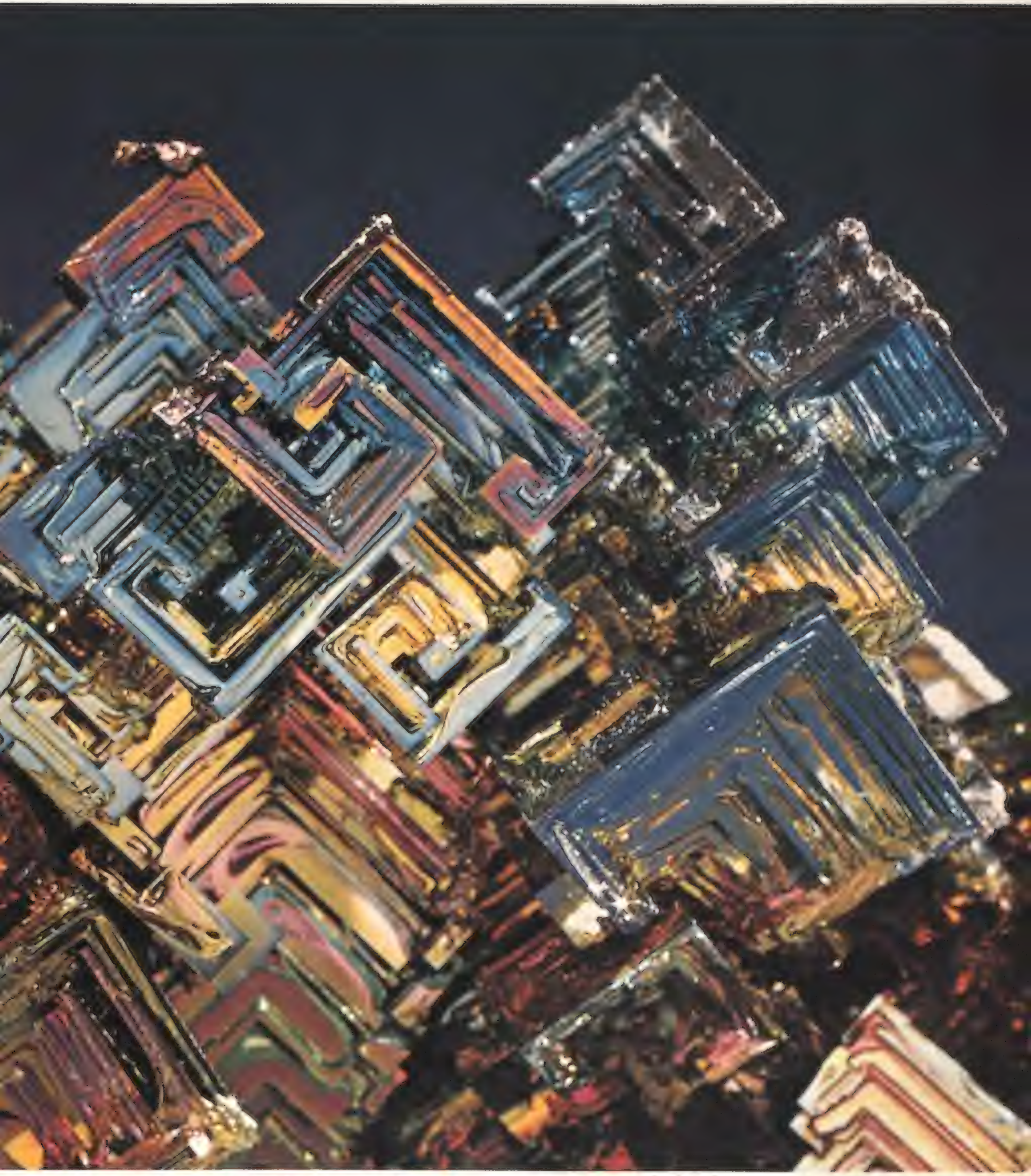
Until recent times nature almost had a monopoly on growing crystals. This is no longer true. The way crystals grow in nature and the constituents they grow from have been extensively studied in the laboratory and imitated—and for very good reasons.

Synthetic crystals are at the heart of our technological society. They are essential in computers and other electronic equipment and, in the form of lasers, they may provide the key to the production of limitless energy on Earth. Yet relatively few people know that the technology of crystal-growing exists, let alone that it has spawned a multibillion-dollar industrial offspring. This is understandable: Most crystals produced by industry are used by industry, not by consumers.

Until recently little systematic effort had been made to document achievements in synthetic crystal growth, or to preserve first-grown and unusual crystals for future generations. This situation has changed with the inception two years ago of the new National Synthetics Collection in the Smithsonian's Department of Mineral Sciences. It includes the specimens illustrated in this article, plus hundreds more from almost every major crystal-growth laboratory in the United States, and is the source of an exhibit on display in the National Museum of Natural History until September 3.

A crystal is solid material—and all true solids are crystalline. Every atom in a solid has definite neighbor atoms, all at fixed distances and relative positions.

The fixed pattern of atoms in a specific crystal gives it constant and recognizable properties. Occasionally



This orderly array of crystals of the metal bismuth has no technological use but is easily grown. Unlike most crystals, these tarnish immediately after growth, thus gaining an attractive iridescent film.

These rubies were made by dribbling powdered chemicals through a flame onto ceramic rods.

Red crystal called KRS-5 is made by melting a yellow powder. Two fluorite crystals are made similarly.

"mistakes" occur when a crystal grows in nature: Atoms that do not normally belong are incorporated. These are termed impurities and they have a great effect on the properties of the host crystal. After much experimentation in synthesizing crystals, man has learned how to add impurities selectively and in controlled amounts (a process called "doping," in which the additives are termed "dopants"), and thus tailor the properties of crystals for specific purposes.

It is important to differentiate between *synthetic* and *imitation* materials. Synthetic crystals are manufactured from simple components, and the very word synthesis means "put together." A synthetic gemstone can be chemically, structurally and physically the same as its natural counterpart. The same mineral constituents must be mined from the ground and purified and, when placed in the proper conditions, their atoms will be rearranged into the desired crystal. Synthetic ruby, for example, *is* ruby. The laboratory process used to make it may not be the same as that used by nature (as explained later) but the end result is material that is the same. In fact, the synthetic product is generally finer in color, purity and transparency than that made by nature.

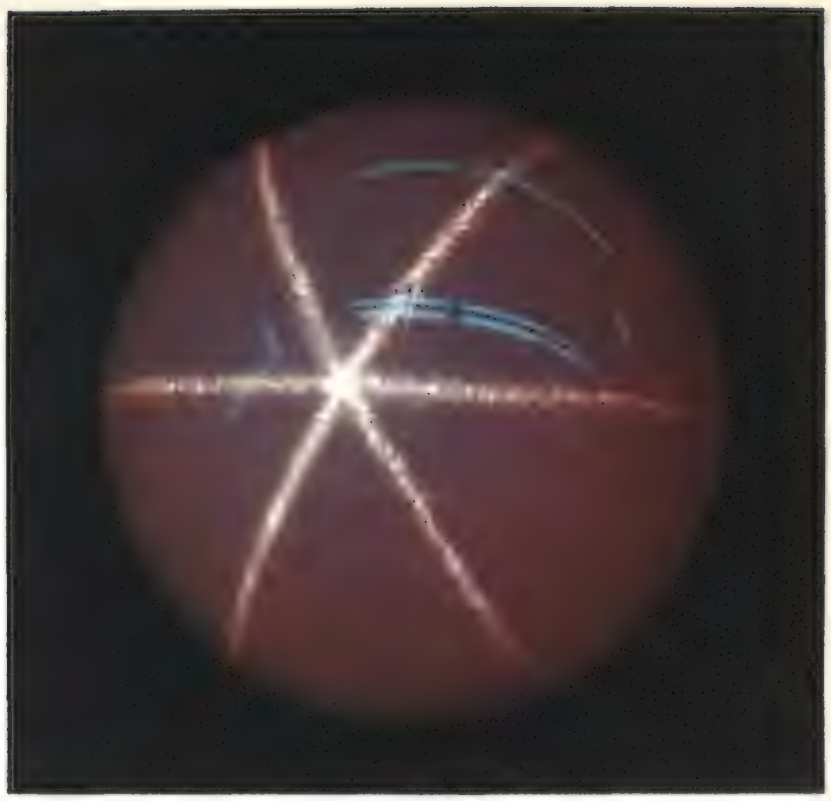
An imitation, on the other hand, is a material with properties that mimic those of a different, more costly material. Glass, for example, has long been used as an imitation—and a very poor one—for ruby, sapphire, zircon, emerald and other stones. But recent technology has produced some remarkable crystals with much better imitative characteristics; a major emphasis has centered on finding a substitute for diamond.

Diamond is not only a girl's best friend, it is also the friend of the industrial machinist, for it is one of the finest abrasive materials known. The demand for industrial diamond is so great that it could swallow up all the stones mined, including the mere five percent suitable for gem use.

When cut as a gem, diamond has a dazzling display of colors. The colors are due to dispersion, the ability of a material to separate white light into its component colors. Diamond is not the only material with high dispersion, but it has the best combination of dispersion, hardness and transparency.

In the late 1940s synthetic gems with incredibly high dispersion appeared on the market under a wide variety of trade names. These gems were made of titanium dioxide, which occurs in nature as the mineral rutile. A disadvantage of synthetic rutile as a gemstone is its relative softness and distinct yellowish body color. Also, its dispersion is so high that cut stones do not really look like diamonds. They are much *too*

*Dr. Arem is a crystallographer, founder and curator of the Smithsonian's National Synthetics Collection.*



From such ruby crystals as those on opposite page, a perfect, though synthetic, star ruby can be cut.

colorful (see page 74). The yellow problem was bypassed with the introduction of a different synthetic crystal: strontium titanate. Gems of this material are colorless and have the high dispersion of rutile, but their relative softness makes them less desirable than more durable stones.

In the late 1960s a completely different material emerged victorious among diamond imitations. Yttrium aluminum garnet, known in the gem market by its acronym, YAG, was originally grown for use in lasers. YAG, doped with the rare earth element neodymium, yields lasers with very high efficiencies. When carefully cut, however, YAG affords gems that have the brilliance and colors of diamond. In addition, YAG is quite hard and durable. Marketed under dozens of trade names, this synthetic material is the most successful diamond imitation ever produced (see page 75).

Diamond itself has been synthesized also by an elaborate and costly method first announced by the General Electric Company in 1955. Since that time millions of carats of synthetic diamond have been produced for industrial use, but gem-sized crystals are so expensive to make that they cannot be profitably marketed. The largest synthetic diamond gem crystals weigh only about one carat and gems cut from such crystals weigh less than half a carat.

Nearly all of the other so-called "precious" gems have been synthesized—emerald, ruby, sapphire, opal, quartz and spinel. In most cases the man-made product is more transparent, freer of inclusions and finer in color than the natural counterpart. Ruby is simply the

red variety of corundum, a mineral that occurs in many colors (the rest are all called sapphire). Star sapphire and star ruby have both been synthesized. (See photograph page 73). The mysterious stars in gems are due to the presence of minute inclusions. Light reflecting from such inclusions creates a "sheen," which is concentrated into sharp lines when the gem is cut. In corundum the inclusions are tiny needles of rutile, oriented within the host material according to the symmetry of the host's structure. The symmetry of corundum is hexagonal, so the resulting star in the crystal is six-rayed.

Occasionally, despite careful control of the growth process, accidents occur. These events produce strange, deformed crystals or aggregates, which owe their existence to essentially random growth conditions. Since natural crystals grow in similar circumstances, the "misfits" of laboratory growth often resemble mineral specimens. (Opposite page, upper right). In such cases we can study the synthetic for insight into natural conditions. Most man-made crystals, however, have distinct and predictable characteristics that reflect the growth technique that produced them.

The trick in growing a crystal is to get the atoms and molecules that make up the crystal to arrange themselves in the periodic, orderly arrangement characteristic of the solid material. This can be done in several ways. If the atoms are bouncing about in the form of a vapor, they must be condensed. If they are sliding over one another in a pot of molten material, the melt must be chilled and solidified. If the atoms are floating about in solution, they must be precipitated out. This gives us three basic methods of crystal growing: from a vapor, from a melt and from solution.

Growth from vapor is usually very rapid. The growing crystal tends to spread out rapidly into the nearest, coolest part of the environment surrounding it, resulting in elaborate spikes and branches. This accounts for the lacy spider-web appearance of snowflakes, which grow from water vapor high in the atmosphere. Such intricate, branched crystals are called dendrites, and dendrites are characteristic of vapor growth. Dendrites can also form from a melt, as a result of rapid cooling.

Metals are the most familiar crystalline materials grown from melts. Every time a steel mill pours ingots it is creating masses of crystals in the molds. There is no control over the cooling process, so many crystals form simultaneously and grow against each other—a state of affairs that is undesirable to the crystal-grower. His aim is to carefully control the growth process and thus allow the formation of only a single crystal. There are three basic techniques of melt growth currently in use to do this job.

The simplest is called the Bridgman-Stockbarger method after the scientists who invented it. In this technique a powder of the desired crystal (or a mixture of components) is poured into a specially shaped container, lowered into a furnace and melted. The container has a conical bottom that tapers to a small point. When this vessel passes through the furnace and emerges at the bottom, the tip is the first part to cool, and a single crystal generally forms there. The pot is lowered slowly from the furnace and, as the melt solidifies, atoms from the melt attach themselves to the solid, extending the growing crystal. Eventually the whole melt solidifies, and the result is (ideally) a single crystal.

Many substances are grown by the Bridgman tech-

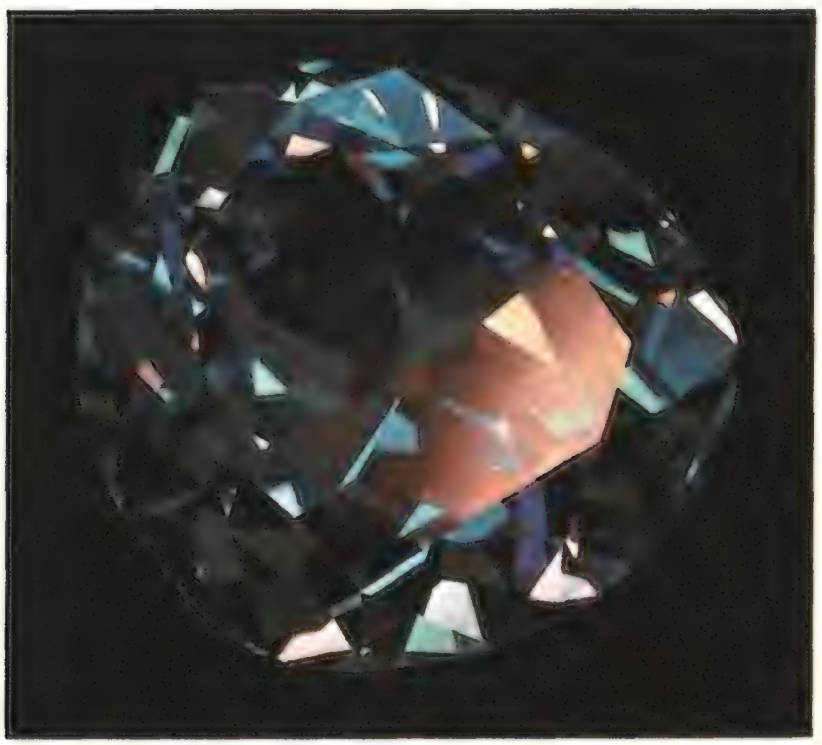
A diamond imitation, synthetic rutile sparkles with a color display too dazzling to seem real.

nique. Halite (table salt) is vital not only to life, but to the chemical industry as well. Large, transparent masses of halite are needed from which to cut lenses and prisms. These are incorporated in specialized optical devices used in chemical analysis and quality control. Such masses are grown from a melt, in the form of ingots that may weigh hundreds of pounds. A related material, cesium iodide, is grown in Bridgman ingots weighing more than half a ton. These behemoths are the largest crystals yet grown by man.

One technique for ruby synthesis, first developed in France in the 19th century by Auguste Verneuil, involves growth from a melt. In the Verneuil method, powdered material (for ruby and sapphire the powder is aluminum oxide containing a trace of the proper impurities to produce the color) is dribbled from a hopper through an intensely hot oxy-hydrogen torch flame. The powder melts and forms tiny droplets that fall, in a kind of "molten rain," onto a ceramic rod (see photograph, page 72). The rod is rotated and slowly lowered as the crystal builds up on its tip. Verneuil crystals up to eight inches long are routinely made. This process can be automated, and some gem crystal factories boast more than a thousand simultaneously operating crystal furnaces. The output of such factories is measured in tons, rather than carats. Verneuil growth accounts for most of the rutile, strontium titanate, gem ruby and sapphire, spinel, and many research crystals produced today.

A vitally important melt-growth technique is generally called "crystal pulling," or the Czochralski technique (named for its inventor). A rotating rod con-

Natural look: drab sapphire plates plus two other kinds of crystals are formed in an industrial mistake.



YAG, hard and durable, is useful for lasers; when cut, it is the most successful diamond imitation.

In nature zincite is red, but such yellow treelike crystals (dendrites) form in furnace in zinc refining.

taining a slice of the desired crystal is lowered down to a vessel containing the same material in molten form. The rod is touched to the melt, held there briefly, and then slowly withdrawn. Some material from the melt adheres to the rod and is pulled sufficiently out of the melt to solidify. This process continues as the rod is withdrawn. The solidifying material builds up a single crystal on the end of the rod (see photograph, at right).

Czochralski growth accounts for some of the largest and finest crystals yet produced. Ruby crystals three inches in diameter and 20 inches long, sapphires weighing nearly 15 pounds and silicon crystals nearly three feet long are typical of routine industrial production. Silicon is extremely important, because it is the basis of much of the technology of transistors, a primary ingredient now of our electronic age.

Crystal growth from solution is the most familiar to all of us. If you swim in the ocean and then sun on the beach, your skin is soon covered with a fine crust of salt. This crust is made up of tiny crystals that grew from the ocean water as it evaporated from your skin.

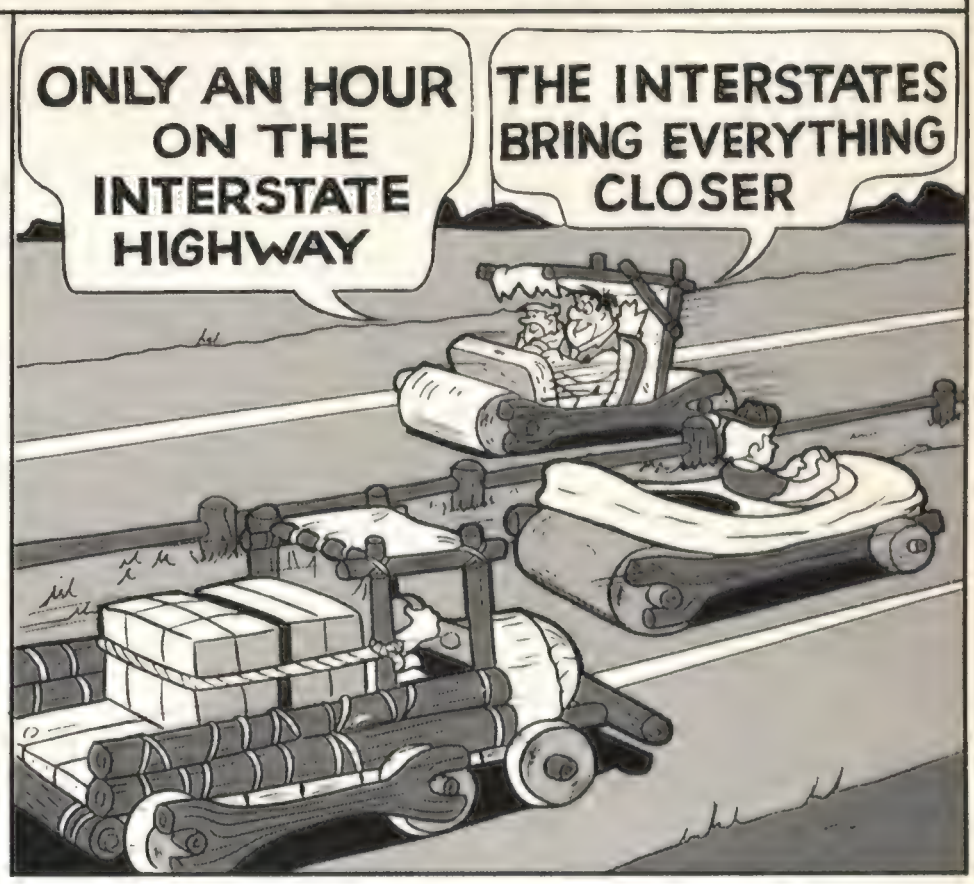
Growth from solution is the way most natural crystals grow. Even in the human body, the growth of bone occurs through the deposition of a mineral material from solution (as do, less happily for us, gallstones and kidney stones). On a larger scale, and with considerable modification, this process can be controlled to produce a wide variety of extremely large and perfect crystals used in the electronics industry. For example, since World War II, quartz has become an increasingly vital material: Large perfect quartz crystals are needed to make oscillators in communications equipment and the production of these has become a considerable industry.

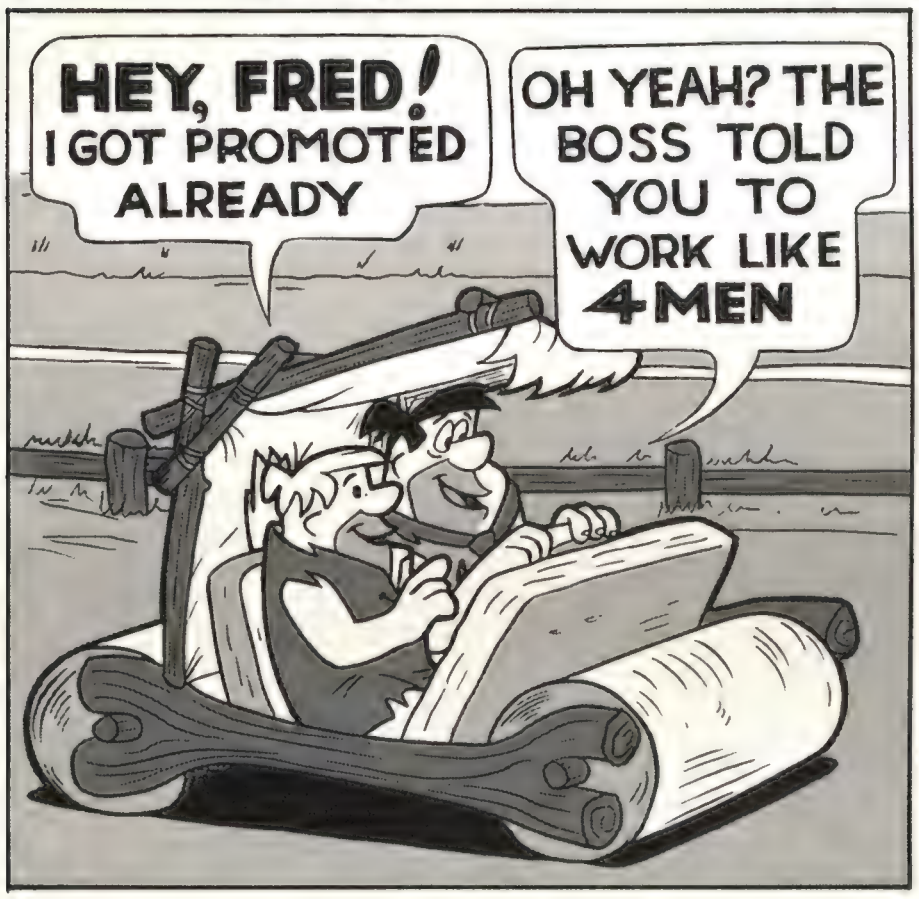
Synthetic crystals of quartz are grown from solution at high temperatures and high pressures—a process called hydrothermal growth. A hydrothermal "bomb" is a steel can that is filled with water, seed crystals and feed material (lumps of impure natural quartz), and placed inside a furnace. At temperatures of several hundred degrees the water vaporizes and creates high pressures inside the can. Under these conditions water is a powerful solvent; it dissolves the impure quartz, circulates inside the can and deposits the dissolved material on the seed crystals.

Whatever the future holds for society, there is little doubt that synthetic crystals will play an increasingly important part in the emergence of the technology that keeps it running.

When a silicon crystal is pulled too quickly from molten material, such bizarre ten-inch forms can occur.

# FRED and BARNEY drive the INTERSTATES



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# *Book reviews*

*Giant Reptiles*
Sherman A. Minton jr. and Madge Rutherford Minton
(Scribner's, $9.95)

How big is a giant reptile? The Mintons define as giants any crocodilian or lizard more than six feet long (a Komodo dragon may reach ten feet), snake more than ten feet and turtle more than two feet. These present-day reptiles hardly compare with the ancient dinosaurs. Still, most of these giants are flesh-eaters. Your type of flesh? No! But you may wonder, uneasily, about your possibilities as a tasty snack.

Personal encounters with giant reptiles have generated an abundance of tales, some true and some not so true. The Mintons have mined these tales for facts and have produced an exciting story of truths. Each of the four groups of reptiles is treated separately as to which of their members are giants, the natural history of the giants, their interaction with man, and the myths that have developed because of their size. The Mintons have written a smooth-flowing story that educates while providing enjoyable reading.

The records are there, too. You will discover the record lengths and weights of your favorite giant, their largest meal and their maximum age. Most of all, you will discover how little we actually know of their ecology and normal behavior. Because of their size, Man is intimidated by them and assigns them to a rapid death with a club or a prolonged death behind bars and glass.

Like many animals, their continued survival is threatened by our increasing modification of the landscape. Because they are big, they require more living space than their smaller reptilian cousins, and so-called land development has exiled them from much of their former range. Furthermore, their skins make beautiful leather goods and their flesh is highly regarded in folk medicine and aphrodisiacs. They are being hunted to the point of extinction. The situation is fortunately not hopeless, for this past February an international diplomatic conference was held in Washington and placed almost all of the reptile giants on a list of banned imports and exports.

A Komodo dragon: Indonesian giant lizard

Why conserve giant reptiles? For future generations to see? Yes, but even more because giant reptiles have as much right to live as any other animals. We must know and understand them better if we are to share this world with them. The Mintons' *Giant Reptiles* is a delightful way to gain this knowledge.

—*George R. Zug*
Assistant curator (reptiles and amphibians)
National Museum of Natural History

*The Man Who Lost America*
Paul Lewis
(Dial, $7.95)

In October 1777, a British army which had moved down into the Hudson River valley from Canada was surrounded and defeated by Americans at Saratoga. This provided the fillip needed to get France involved in the American Revolution, a decisive factor in our final victory over Britain. Thus, one can say that the commander of that expeditionary force, General John Burgoyne, was really "the

man who lost America" for the British.

Those are the bare bones. Those of us who crave a little meat on them smack our lips over juicy incidentals: Burgoyne traipsed through the wilderness with 43 baggage carts containing food and wine fit for an aristocratic palate, spare uniforms and more than 200 books. His army included officers' wives, with one of whom he dallied nightly. He was known as Gentleman Johnny and, of all things, he wrote plays.

These facts seem to make this enemy general an eminently satisfactory victim of our patriotic ardor. He comes across to our schoolchildren as the very antithesis of our sturdy, virtuous, devoted, homespun, egalitarian forefathers.

Now here comes a book that adds a strange new flavor to Gentleman Johnny Burgoyne. It seems that when he became colonel of his own regiment, he shook the British military system down to its gaiter buttons by forbidding "bloody-backing," the Scavenger's Daughter (tying of neck and heels), clubbing, kicking and other forms of abuse normally visited on enlisted men by their officers. For this he won the devotion of his men. They invariably fought their hearts out for him—and that includes Saratoga where, outnumbered at least two to one and starving, they came within a whisker of winning the last crucial battle.

We also learn that Burgoyne had a lovely wife to whom he was astonishingly faithful while she lived (until 1776); that he actually wrote some pretty good plays and was mentioned in the same breath as his friend Richard Brinsley Sheridan. He also was a member of Parliament—a Whig who, with his friends Charles James Fox, Edmund Burke and the Earl of Chatham, strongly espoused the American cause and fought bitter political battles to gain justice for the Colonists.

When fighting began, he doffed his parliamentarian's wig and donned the scarlet and gold of a general. His plan to end the war was a sound one, foiled—deliberately, one suspects—by Lord George Germain, a disgracefully inept, jealous and corrupt Minister of State.

Paul Lewis, the author of this fine biography, is a pseudonym. His picture of Britain's leading general has a clarity and candor that gives a whole new perspective to those emotional times when our nation was aborning. We meet an enemy who was honorable, likable and coura-


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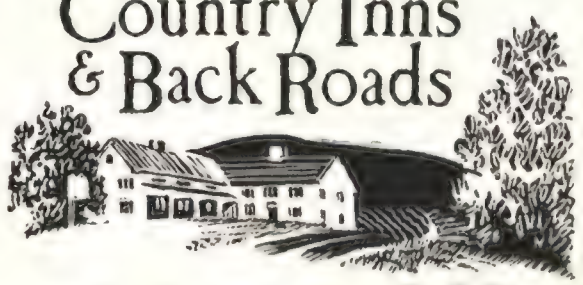

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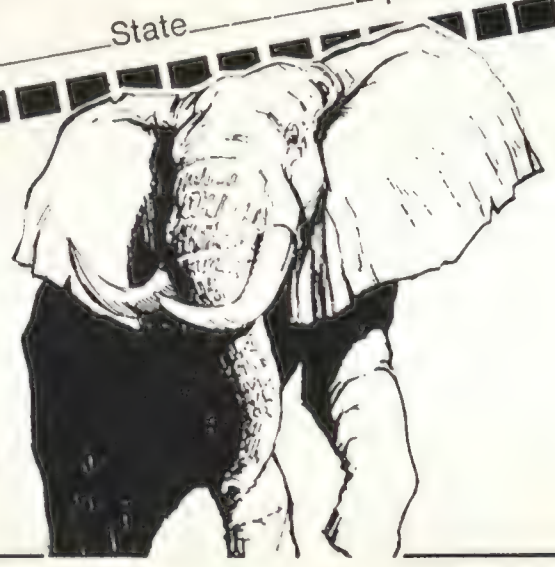

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—*Edwards Park*
Board of Editors, SMITHSONIAN

*Divas*
Winthrop Sargeant
(Coward, McCann & Geoghegan; $7.95)

This is the golden age of sopranos, declares retired *New Yorker* music critic Winthrop Sargeant. For proof, he rings up the curtain on half a dozen of the giants—Joan Sutherland, Marilyn Horne, Beverly Sills, Birgit Nilsson, Leontyne Price and Eileen Farrell—in a brisk series of warm and witty portraits.

Singers are happy people, Sargeant assures us, and why not? They love to eat, and getting fat only enhances their vocal prowess. They share the yogi's reward of physical and spiritual serenity that comes from proper breathing. They are even singing higher than ever. Today's orchestra, tuned a half tone higher than the orchestra of Beethoven's day, may rise another half tone during a vigorous performance—pushing Miss Sutherland's breathtaking high F to a cosmic G.

*Divas* will take its place on the opera buff's bookshelf next to Henry Pleasants' classic *Great Singers*. But it is a book for near-fans, as well, shot through with tantalizing private sidelights and small bright nuggets: Marilyn Horne's pride in her Louis Armstrong imitation; Joan Sutherland's reluctant admission that she sings "like an angel" when she's mad. And who could resist the saga of Brooklyn's Bubbles Silverman: at nine, a mini-Lily Pons warbling the Bell Song from *Lakmé* on Major Bowes' Capitol *Family* radio program; at ten, chirping "Rinso white, Rinso bright, happy little washday song" to a daytime audience of housewives; and today, New York City Opera's first lady—Beverly Sills.

It is not all caprice; there are dark moments. Miss Sills speaks of her son and daughter, each born with a handicap. Leontyne Price describes the inner turmoil afflicting every "token black" in the performing arts. But the book's spirit is more accurately captured in a chatty aside from the world's greatest Wagnerian soprano sharing her secret of endurance:

Singing Isolde is not really so difficult, Birgit Nilsson confides—as long as you have a comfortable pair of shoes.
*—Joan Downs*
Formerly a writer on music for *Life*

*The White Rhino Saga*
Ian Player
(Stein and Day, $6.95)

It is good to be able to stop among the alarms bugled up by some ecologists to contemplate a straight-out triumph: the saving of a doomed species. And what a genuine pleasure it is to find the story told so well in Ian Player's new book.

Simply to go about South Africa's Umfolozi Game Reserve with Player, sharing his knowledge and love of the country, people and animals, is a reader's delight.

The story opens in 1953, when all of the surviving southern race of the white rhino were in the Umfolozi country. There were by aerial count 437, a remnant of thousands that, within the last century, fed over the southern half of Africa. This number marked a happy increase from the 40 to 80 believed in existence in the late 1890s, when the game reserve was established.

By 1953, the Umfolozi's 72,000 acres were no longer enough; the rhino were eating themselves out of fodder and destroying the reserve itself. By this time there were other preserves that would welcome white rhino, many nearby in Africa, others scattered around the world. There are zoos aching, not only to draw gawkers, but to save species.

But you can't spread rhino about like butter. These are 4,000-pound beasts, second largest of land animals, peaceable in the wild (unlike their black cousins) but fearsome when roused. Eventually, with Player taking a leading role, the spreading has been accomplished.

There was available expertise in shooting drug-loaded darts into many animals, but none with the white rhino. The first dosages were too high and precious rhino died. (Player makes one death scene both wildly amusing and deeply touching as the rangers try to give artificial respiration by jumping up and down on the animal's great chest while the scientific leader—an ingenious character with the peculiar habit of writing his notes on his legs—dejectedly pumps antidote into the rhino's ear vein.)


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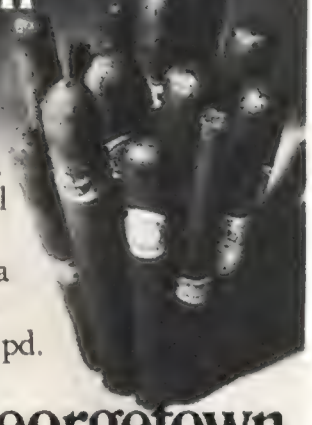

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After dosages and techniques were straightened out, other troubles arose. Animal quirks, human quirks, governmental absurdities and floods plagued the effort. At one point armed poachers and squatters came close to a shooting war with the rhino-saving team.

All difficulties seem to have been overcome: The white rhino are now established in 54 new African locations and about 60 other homes in North America, Europe and Asia. As the book ends in March 1972, a total of 1,109 of the prehistoric beasts have been successfully shipped, and Player can report: "The small team of dedicated men it had been my pleasure to lead had achieved miracles. We could . . . say to the world, we have saved the white rhino for you; we have made our contribution to the next generation."

*—Frank Sartwell*

Washington free-lance writer and author of two SMITHSONIAN articles

*Sex and Marriage in Utopian Communities: 19th-Century America*
Raymond Lee Muncy
(Indiana University, $10)

"We are a little wild here with numberless projects of social reform," Ralph Waldo Emerson wrote to Thomas Carlyle in 1840. "Not a reading man but has a draft of a new community in his waistcoat pocket."

Then as now, the vision of a new social order based on communities of the like-minded inflamed the imaginations of those who were discontented with the psychic and social ills of American life. Nineteenth-century America had a fervor for experimentation in life-styles that has not been matched until now.

In centering his study of such communities around sexual roles, Muncy takes note of the fact that strict monogamy was a well-recognized threat to a commune since a nuclear family was always going to put its own interest before the common good. Each 19th-century community tried to allay the threat, either by diluting the matrimonial tie, banishing it altogether, enforcing celibacy or attempting the then-radical solution of removing all sexual taboos.

All of the communes recognized the need to give women viable alternatives to marriage and, in their emphasis upon economic and social equality, were precursors of Women's Lib.

But communes that tried to strike an uneasy balance with marriage failed. "Free love" was considered heretical by the outside world and only the celibates were left to pursue their utopian visions undisturbed.

The 19th-century commune is a subject that calls for imaginative analysis and informed interpretation. What it gets here is a historian's mesmerized fascination with facts: how the community was founded, what its rules were, how many people lived on what acreage for how much money. Who were these people? What private despairs drove them to radical experimentations with communes, and why did they desert in droves? Such questions remain unexamined, along with personal case histories which bring statistics to life.

But the deepest disappointment of this book is the obvious questions it leaves unanswered. After an early reference to some 2,000 contemporary communes in 34 states, the author makes no attempt to put them into the historical perspective that his research has provided. One might deduce from this book that the chances of successful communities are much better now, since the absolute ties of marriage are much eroded, the position of women is vastly improved and progressively fewer people find their sensibilities outraged by the idea of "free love."

In fact, contemporary philosophers on communes are focusing more attention on the care of children than on sexual relationships as such, indicating that the latter are much less of a threat than they were 100 years ago. But one is not given this kind of conclusion in this turgidly pedestrian account of a fascinating social experiment that didn't quite come off.

*—Meryle Secrest*

A *Washington Post* editor, and author of several SMITHSONIAN articles

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Unfortunately, a tragic gap separates what we can do from what we *are* doing. As other articles in SCIENTIFIC AMERICAN have shown, our health care system, responsible for delivering the blessings of medical technology to the people, is shamefully disorganized, outdated and expensive—resulting in needless pain, physical damage and death.

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For information: Miss Bliss Schumann, Room 123 SI, Smithsonian Institution, Washington, D.C. 20560.

*African Safari and the Seychelles:* Tanzania and Kenya game parks, plus the Seychelles in the Indian Ocean—July 17-August 7 (waiting list only).

*Mexico and Guatemala:* Historic sites of Yucatán, Oaxaca, Mexico City, Tikal and Antigua (depart and return Miami)—August 27-September 14.

*Aerospace Museums:* A nontechnical tour of these special museums in Munich, Lucerne, Moscow and London—September 17-October 3.

*Copernicus:* Polish and Italian cities where Copernicus lived and worked, including Krakow, Frombork, Torun, Warsaw, Bologna and Padua—October 1-21.

*West Africa:* Historic sites from Mali to Senegal—January 8-February 1, 1974.

*India and Nepal:* Emphasis on architecture and museums—January 18-February 10, 1974.

*Sites of Civilization:* Cruise from Rome to Athens—April 6-27, 1974.

*Greece:* A tour of sites and flowers on the mainland and Peloponnesus—April 27-May 12, 1974.

*Ethiopia and Kenya:* Ancient and contemporary cultures from Aksum to Lalibela, plus several days in Kenya—May 23-June 14, 1974.

*Black Sea Cruise:* Depart and return Athens—September 17-October 6, 1974.

*Afghanistan and Pakistan:* Archaeological and historical sites—October 21-November 11, 1974.

**Domestic Study Tours**

For information: Mrs. Patricia Kilkenny, Room 106 SI, Smithsonian Institution, Washington, D.C. 20560.

*Olympic National Park:* Accompanied by a Smithsonian horticulturist, visit Washington's alpine meadows, mountains, lakes and rain forests; take a side trip to Victoria, British Columbia—June 24-July 1.

*Alaska Float Trip and Cruise through Prince William Sound:* July 18-August 1 (waiting list only).

*Archaeology Dig:* Participate in working project in Concord, New Hampshire—weeks of August 5 and 12. Students only—week of August 19.

*Acadia National Park, Maine:* Experience the craggy shores and rugged cliffs of this New England national park—September 9-15.

*California Colonial History:* Explore the architecture and history of Hispanic California from Los Angeles to San Francisco, including the missions, Morro Bay and Monterey—September 16-23.

*Sea and Shore Laboratory, Charlotte Harbor, Florida:* Using the facilities of the Mote Marine Lab, participate in ongoing research problems concerning birds and shallow-water animals—October 11-18.

*Big Cypress Swamp and Everglades National Park:* Explore and learn the natural history of these regions in southern Florida—November 11-18.

*Louisiana Plantation Architecture:* Tour the historic and unique architecture of southern Louisiana—November.

*Christmas at the Smithsonian:* Enjoy a weekend of cultural activities and Christmas tradition at the Smithsonian—December 7-9.

# *Smithsonian highlights*

*Division of Performing Arts*
The seventh annual Festival of American Folklife will run from June 30 through July 8 and will be held in the area around the Reflecting Pool between the Lincoln Memorial and the Washington Monument. The festival will feature singers, musicians and craftsmen from Kentucky; musicians and dancers from Yugoslavia and Serbo-Croatian communities throughout the United States; carpenters, bricklayers and skilled workers from the nation's building trades; and American Indian craftsmen and dancers from the Northern Plains.

"Alice in Wonderland" continues at the puppet theater, Arts and Industries Building. Performances are at 10:30 and 11:30 A.M., Wednesday through Friday, and at 10:30 A.M., 12:30 and 2:30 P.M. Saturday and Sunday. For ticket information, call (202) 381-5395.

*Museum Summer Hours*
Four Smithsonian museum buildings will be open from 10 A.M. to 9 P.M. each day through September 3. Included in this schedule are the History and Technology, Natural History, Arts and Industries and Air and Space buildings.

*Parking on the Mall*
Metro construction has made parking on the Mall near the Smithsonian complex extremely difficult. All parking prior to 10 A.M. is restricted. The use of fringe parking areas and/or public transportation is recommended whenever possible. Current parking information may be obtained by writing to the Smithsonian Associates' Reception Center.

**Museum Reference Service**

The Smithsonian Associates' Museum Reference Service is available to members traveling within the United States. Associates may write for a packet comprised of lists, by state, of many of our country's museums, galleries and historical sites. Brochures are included when available. Please specify the states in which you will be traveling. Allow three weeks for mailing. Write: Smithsonian Associates' Museum Reference Service, Associates Reception Center, Smithsonian Institution, Washington, D.C. 20560.

*Museum of History and Technology*

The Henry R. Luce Hall of News Reporting features an audiovisual chronicle of the colorful history, important personalities and technological advances of American journalism.

*Museum of Natural History*

"Synthetic Crystals" is a comprehensive survey of man-made crystals, showing how they are made, what they are used for and how they differ from natural crystals (see article p. 70).

*National Air and Space Museum, Arts and Industries Building*

"Exhibition Flying" is represented by the barnstorming Waco 9 (1920-1939); the Turner RT-14, designed exclusively for racing; and the Pitts Special, the type of plane used recently in the World Aerobatic Championships. A replica of the air show grandstand, with a continuous showing of films of the internationally acclaimed National Aerobatic Championship team, is open to the public.

**Smithsonian Speakers**

The National Speakers Bureau is a service provided by Smithsonian Associates which offers an opportunity for organizations within the United States to request curators and other Smithsonian staff members to lecture on a wide spectrum of disciplines. Travel and other expenses are paid by participating organizations. Write: National Speakers Bureau, Smithsonian Associates, Smithsonian Institution, SI 118, Washington, D.C. 20560.

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The Gregg Smith Singers will present a concert in the Grand Salon on June 5 at 8 P.M. Proceeds will be used to restore an 1873 Steinway grand piano as a permanent fixture for the Renwick. For ticket information, call (202) 381-5157.

*National Collection of Fine Arts*
"Three Contemporary Printmakers: Jacob Kainen, Albert Christ-Janer and Tadeusz Lapinski" is an exhibition of these widely known American artists' most recent lithographs—Opens June 1.

"Divergent Representation: Five Contemporary Artists" is the first NCFA exhibition organized by Walter Hopps, visiting curator of contemporary art. It focuses on the divergent directions currently pursued by some American representational artists—Opens June 15.

"Lilly Martin Spencer, 1822-1902: the Joys of Sentiment" is a retrospective of some 30 paintings, 28 drawings and 10 prints by this foremost American artist—Opens June 15.

*Freer Gallery of Art*
"Ukiyoe" is a special exhibition of this unique school of Japanese painting that developed in the late 16th century. Including more than 100 paintings from the Freer collection, this show is the first of three planned to commemorate the 50th anniversary of the Gallery.

*Traveling Exhibition Service*
There are up to 70 different Smithsonian-sponsored exhibitions on display each month throughout the United States and Canada. For a complete listing and information on how to bring an exhibit to your area, write: Traveling Exhibition Service, Smithsonian Institution, Washington, D.C. 20560.

- Amarillo, Tex.—"William H. Johnson" (Amarillo Art Center, June 16-July 15).
- Champaign, Ill.—"The Monotype: An Edition of One" (Krannert Art Museum, June 24-July 22).
- St. Louis, Mo.—"The Art of the Comic Strip" (Missouri Historical Society, June 30-July 29).
- Ft. Smith, Ark.—"Story of a Goblet" (Ft. Smith Art Center, June 30-July 20).
- Ardmore, Okla.—"Paintings by Children of Many Lands" (Charles B. Goddard Center, June 16-July 15).
- New York, N.Y.—"Greenland, Arctic Denmark" (American Museum of Natural History, through Aug. 5).
- Philadelphia, Penna.—"Samit" (American-Swedish Historical Museum and Foundation, June 2 to July 1).

*French masterpieces from the USSR*
Widespread interest in the exhibition of modern French paintings from the Russian collections (April SMITHSONIAN) has led the Soviet government to extend the loan period so that more Americans may see it. Added to the original itinerary are the following institutions: The Los Angeles County Museum, June 13-July 8; The Art Institute of Chicago, July 18-Aug. 12; and The Kimbell Art Museum, Fort Worth, Aug. 22-Sept. 16.

*Smithsonian Commons*
Luncheon facilities for members of the Smithsonian Associates are in the original Smithsonian Building. Open Monday through Friday from 11:30 A.M. to 2 P.M., the Commons offers a buffet luncheon from $1.40 to $1.85 upon presentation of an Associate Membership card.

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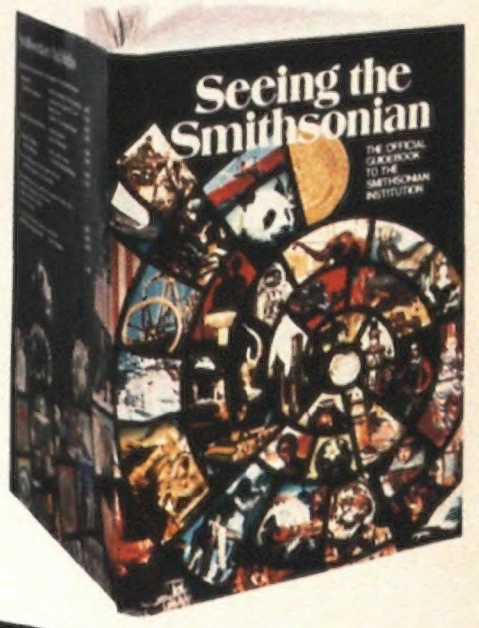


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*By Patrick Ryan*

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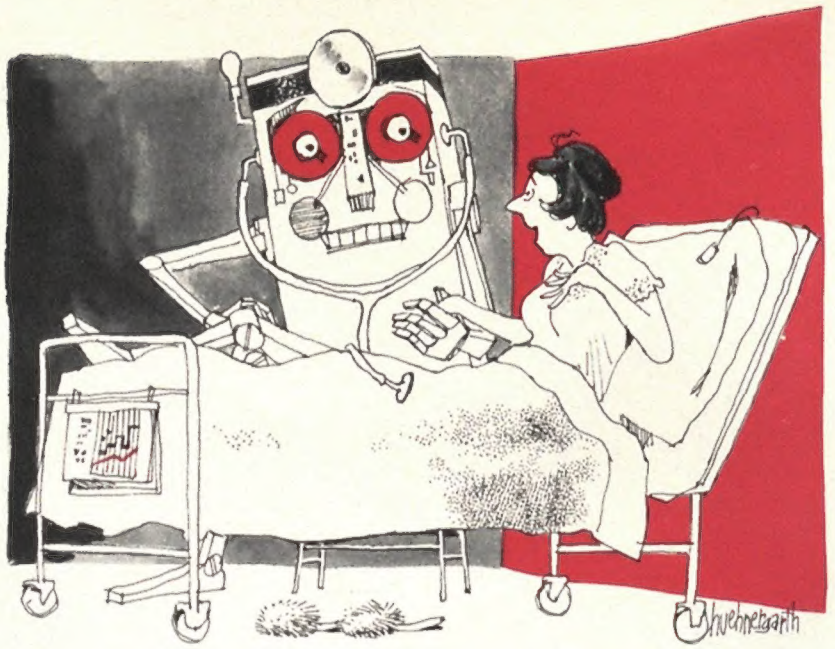

Nothing, as ever, is sacred, and, though the dust of Hippocrates may quiver in his grave, the computer is creeping up on the doctors. Its automated bedside manner has been judged superior to that of many medicos in persuading people to give intimate details of their personal problems.

"Patients seem to be more at ease with the computer and feel less self-conscious," explained Dr. Alan Bailey, head of research in the British United Provident Association, a large private medical insurance concern in Britain. Computers programmed for progressive interrogation have been used in their specialized diagnostic service, where it was found that clients were willing to give the faceless machine more information about their smoking, drinking and sex troubles than they would comfortably confess to live physicians.

This preference for mechanical rather than human conversation is not simply another expression of traditional British reserve. It is also supported by the opinion of Dr. Laurence Weed, professor of medicine at the University of Vermont, that the medical care system in America based on the doctor-patient interview has failed catastrophically. He has urged, in consequence, that doctors use computer-interview systems which could delve into problems which neither the doctor nor the patient might suspect were related to the apparent complaint.

Thus, on both sides of the Atlantic, the future day may now be discerned when genteel medical computers will take over from our neighborhood doctors.

It has been professionally estimated in England that some 50 percent of the patients in any doctor's waiting room are only suffering psychosomatically. The cause of our malady is all in our minds and what we've really come for is placebos and sympathy, an ear to bend, and a bit of a cheer-up from a father-figure. Petronius put it neatly as far back as anno Domini, more or less, when he observed that "A physician is nothing but a consoler of the mind."

Could not such compassionate aural services be even better rendered by computers suitably primed to produce leading questions, encouraging noises and soothing murmurs whenever the patient pauses for breath? And, with a little help from a clinically minded programmer, the computer might even be equipped to deal with many among the other half of the waiting-room population who may be afflicted by some actual physical ailment.

In any event, to us honest patients the sight of a five-by-five, gray-enameled computer on the clever side of the consulting-room desk will not be so daunting as was the previous presence of a human, horn-rimmed doctor of medicine, clearly endowed with seven years more education than we had and, as a recognized member of the establishment, distinctly liable to be censorious if we confess the full depravity of our moral weaknesses and alcoholic excesses. And when we're ailing and therefore more fragile, we can rest assured that the rejuvenating performance of the transistorized physician won't be affected by any late-night hangovers, breakfast-time rows with his wife or acid stomachs brought on by worrying about income taxes. Nor will the detailed explanation of every twinge of our esoteric ailments be brusquely terminated after a 20-minute harangue because our electronic leech has an early lunch date with a female anesthetist, a sports event to catch on television or an urgent appointment to keep at the first tee on the golf course.

But we must bear in mind the computermen's aphorism, "Garbage in—garbage out." It must be emphasized that, as medical imitators, those unprimed imbeciles can only be as efficacious as the ingenuity of their programmers can contrive. We may be back where we began.

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